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Experiments on two varieties of Iron, manufactured at the Adirondack works, directly from the Magnetic Ore of McIntyre, Essex county, New York, by WALTER R. JOHNSON, late Professor of Mechanics and Natural Philosophy, in the Franklin Institute, Philadelphia.

The portion of the state of New York bounded eastwardly by lakes George and Champlain, northwardly by the Canada line, and northwestwardly by the river St. Lawrence, embracing the counties of Warren, Essex, Hamilton, Clinton, Franklin, and St. Lawrence, appears from various representations to be peculiarly rich in the magnetic ores of iron. We may refer in particular to Mr. Redfield's account of his exploring visits to the northern sources of the Hudson,* and to Messrs Hall and Emmons' geological reports relative to this part of the state of New York.

Mr. Hall observes that "about a mile north of the inlet of lake Sandford' (the site of the settlement at McIntyre) "in the bed and on both sides of the stream, is a bed of ore which cannot be much less than 500 feet wide, and in all probability far exceeds that breadth. This bed, with one or two minor ones on each side of the stream, has been traced for three-fourths of a mile in a northerly direction, and probably continues much farther southerly, as the great number of boulders and angular fragments of ore lying on the surface and imbedded in the soil seem to indicate. Some of these boulders of ore cannot weigh less than three tons."†

This ore, it appears, occurs in beds, and not in veins, since it lies "parallel to the direction of the mountain ranges, and when in gneiss, parallel to its apparent stratification."

Mr. Emmons, considers‡ "that the beds about McIntyre are parts of a belt of an iron formation, which extends southwestwardly through the wilder-

* American Journal of Science, vol xxxiii, p. 303, Jan. 1838.
† First Geological Report of New York, Feb. 1837, p. 131.
‡ Second Geological Report of New York, Feb., 1838, p. 223.

ness to the town of Chaumont, in St. Lawrence county; and that along the line connecting those places, many beds remain to be discovered. No *one* of these beds of iron may be equal to those of Missouri, still, *put together*, there is a much greater quantity of it, and more advantageously distributed."

The ore at McIntyre is stated to be in immediate connexion with a primitive rock, the chief ingredient of which is Labrador feldspar.

Two varieties of ore were received, accompanying the two kinds of iron, herein referred to. The first variety is of a granular but compact structure, colour of fresh fractures deep black, shining; that of weathered surfaces reddish brown, owing to the formation of a little peroxide; its specific gravity is 4.2322. The second variety has a compound structure, being in part amorphous and in part crystalline. The colour is a brownish black, except that of the crystalline portions, which is jet black. Its specific gravity it 4.6636.

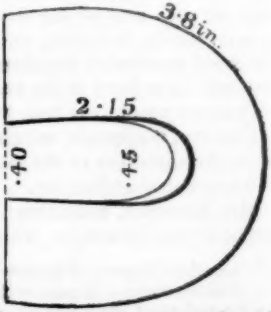
From this latter ore both specimens of the iron were produced, but their difference consisted chiefly in this, that No. 1 was wrought at a higher temperature than that applied to No. 2. The locality of these ores and the site of the Iron Works at McIntyre is about 45 miles westward from lake Champlain, between lake Sanford and lake Henderson, which are one mile apart, and according to Mr. Emmons' barometrical measurement, it is at an elevation of 1889 feet above tide water. The north branch of the Hudson in the distance of this one mile has a fall of 100 feet. The method of manufacture is by calcining the ore in kilns, breaking up and separating the purer parts by revolving magnets, reducing these to a malleable state in a forge fire, and drawing the loup out under a common tilt hammer—ready for the market. This method is likewise pursued by the Peru Iron Company at Clintonville, also at other works in Clinton county, in which about 3 or 4000 tons of malleable iron are manufactured per annum.

The appearance of the two varieties of iron when received was in some respects different. The structure of No. 1, was the more compact and fibrous; that of No. 2, more granular and crystalline, as indicated at the ends where the bar had been cut off with a cold chisel. No. 2 also exhibited two or three dark seams running along it longitudinally, and indicating less perfection in the welding, than would be desirable.

Experiments on No. 1.

To ascertain the toughness and ductility of this iron when cold, I caused the bar to be bent at a temperature of 50° at a part where the breadth was 1.295 inches, and the thickness .59 inch. This bend was made flatwise, and continued until the corresponding faces on the inside, about one inch from the middle of the inner curve, were four-tenths of an inch apart, and the widest part of the opening only .45 of an inch. The alteration in the form of the bar appeared to be limited to this portion. On measuring along the interior and exterior edges of this curve, the former was found to be 2.15, and the latter 3.8 inches, manifesting a difference in the length of the inner and outer fibres of 1.65 inches in a length of about 2¼, the original extent of the bent portion. See Fig. 1.

Fig. 1.



By this trial the whole form of the cross section of a bar is changed, and

instead of straight lines exhibits only curves.—In the present case the parallellogram Fig. 2, was converted into the form of Fig. 3, the largest curve being on the inside of the bend.

Fig. 2.

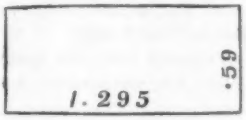
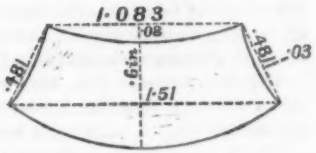


Fig. 3.



This change of figure and displacement of parts were borne without exhibiting any signs of rupture until the curvature above stated had been attained, when a few cracks began to appear, on the exterior part of the curve.

The next test to which this iron was subjected was to heat a portion of the bar to redness, quench it in cold water and then bend the same portion cold, in the manner already described. No difference of result was obtained except a greater facility in producing it. A few slight surface cracks were seen near the close of the operation.

A third trial of a similar kind on a bar annealed and cooled in dry ashes resulted like the preceding, but exhibited rather more cracks on the exterior surface of the bend than either of the foregoing.

Another trial of the toughness of this iron when cold, was made by drawing out a bar .7 of an inch wide, .18 inch thick, and 5.4 inch long, and twisting it cold in the manner of a common twisted auger, twice round in the length just specified. The edges of the spiral were now exactly 7 inches long. Hence, the elongation of the exterior fibres on the edges was $\frac{7.-5.4}{5.4} = 29.6$ per cent. It is proper to state that this experiment was made after annealing the bar, and cooling it off in dry ashes. In attempting to carry the torsion beyond this extent, the bar was twisted off at the jaws of the vice, in which the operation was performed.

Having thus proved that this iron is not under any circumstances *cold-short*, I caused the bar $1\frac{3}{8}$ inches wide, and .6 inch thick, to be heated to a fair working red heat, and in that state bent flatwise over the corner of an anvil, and a right angle exterior and interior to be formed $\frac{3}{4}$ of an inch from the end. The exterior angle remained perfectly sound. On the interior, a thin scale only of metal appeared to be corrugated and partly detached from the rest of the mass, owing, probably, to a defect in welding—but not the least sign of a tendency to fracture was discovered. Another portion of the same bar was heated as before and 3 inches of it bent over and hammered flat upon the face of the adjacent part.

Complaints are made by workmen that much of the iron which they employ will not sustain either of the two preceding operations. They were, however, borne by the iron under trial, without evincing any weakness or undue distortion of parts. A slight splintering, similar to that just mentioned, and on the same side of the bar, was seen in the present case.

A third test of the quality of this iron, when hot, was afforded by heating about 3 inches near the end of the bars and driving a steel punch .8 of an inch in diameter, quite through it. This was done without spliting or cracking at the edges, as is too often the case in making screw nuts. Machinists are well aware of the importance of a good material for the formation of screws and nuts.

The foregoing trials having, it was conceived, fully established the freedom of this iron from the defects known either as *hot shortness* or *cold shortness*, and its softness and malleability being amply tested by the cutting and hammering incident to these experiments, the next step was to determine the absolute force of cohesion, together with the extensibility, when subjected to longitudinal strain, and the interior structure of the metal under various circumstances, including that of welding in the ordinary way.

For this purpose five bars were drawn out and prepared from the specimens already described, numbered I, II, III, IV, and IX, each about 9 or 10 inches long, 1 inch wide and .2 inch thick.

No. I. after being reduced to a nearly uniform size throughout its length, was annealed at a red heat and allowed to cool slowly in the air.

No. II. was *hammer hardened*, or beaten with moderate force, throughout its length until it had been for several minutes black, the hammer being occasionally moistened during the process.

No. III. was forged out and hammered till it was only visibly red in daylight, being left at about the temperature at which workmen cease their operations on many of the articles which they produce.

No. IV. after being brought to a uniform size, was upset for about 3 inches, in the middle, and was then annealed and cooled slowly.

No. IX. was drawn out, cut in two in the middle, and welded together. This sample was only 6¼ inches long.

All these bars were then carefully gauged, both in breadth and thickness, at every inch of their lengths, before commencing the trials of tenacity. The machine employed in testing them was the same which had been used in experiments made at the request of the Treasury Department, on the strength of materials for steam boilers, for a description of which the reader may be referred to the report on that subject.* The following table will be understood without any other remark than that the breaking weights in the 5th column, are corrected for friction of the machine. The specific gravities of several of the fragments of each bar after it had been broken up, are given under the head of observations, and may serve as well to illustrate the general character of the iron in this respect, as to indicate the effect of the several methods of preparation on the density of iron.

The following experiments confirm the evidence already adduced of the great toughness and ductility of this variety of iron. Besides the facts mentioned under the head of *observations* in the 7th column we may add that after the first fracture on each bar, a measurement was taken between two of the inch marks still remaining on one of its parts and the following results obtained, viz:

No. I.	In an original length of	6	in.,	had been elongated	.87	in.	=	14.5	pr. ct.
II.	"	"	4	"	"	.2	"	= 5	"
III.	"	"	5	"	"	.6	"	=12	"
IV.	"	"	4	"	"	.2	"	= 5	"

* See also Journal of the Franklin Institute, vol. xix, p 84.

TABLE I.

Experiments on the tenacity of iron in specimen No. 1.

No. of the bar.	State of the Bar.	No. of the experiment	Area of section before trial in sq. inches.	Breaking weight in lbs, avoirdupois.	Strength in pounds per sq. inch.	Observations.
I.	Completely annealed.	1	.1890	10.175	53.820	Length before trial, 10 inches, after, 13.5—total elongation 35 pr. ct. Sp. Gr. after trial 7.685, 7.676, 7.668. Mean = 7.676. After the 4th fracture the area of section was .1064 in. instead of .1986as at first, diminution 46 pr. ct. Mean strength of this bar 53.311. Greatest difference 1706 lbs =3.2 pr. ct. of the mean.
		2	.1929	10.288	53.336	
		3	.1954	10.345.5	52.945	
		4	.1986	10.374	52.235	
		5	.2036	10.972.5	53.941	
		6	.2057	11.029.5	53.614	
II.	Hammer hardened.	1	.1980	12.967.5	65.492	Length before trial 9⅛ in., after, 11 in. —total elongation 20.5 pr. ct. Sp. Gr. after trial, 7.769, 7.756, 7.779, mean = 7.768. Mean strength 65.713.—Greatest difference 2348 lbs=3.5 pr. ct. of the mean.
		2	.2019	13.053	64.650	
		3	.2000	13.399.75	66.998	
III.	Hammered till nearly black.	1	.1983	11.970	60.363	Length before trial 9.5 in., after 12¼— total elongation 28.94 pr. ct. Sp. Gr. 7.760, 7.778, 7.662, mean = 7.750. After the 2d fracture the area of section at the point of fracture was .1176—diminution 45.2 pr. ct. Mean strength 58.912. —Greatest difference 2.444 lbs=4.15 pr. ct. of the mean.
		2	.2151	12.454.5	57.919	
		3	.2163	12.768	59.029	
		4	.2213	12.910.5	58.339	
IV.	Upset in the centre and annealed.	1	.2086	13.110	62.847	Length before trial 9, after 11.2—total elongation 24.46 pr.ct. of original length, Sp. Gr. after trial 7.813, 7.731, 7.754, 7.634, mean = 7.733. Mean strength 63.142.—Greatest difference 7.128 lbs.= .11.2 pr. ct. of the mean. The last two results belong to the upset portion of the bar. The thickest part of the upsetting remained, however, unbroken.
		2	.2233	13.623	61.007	
		3	.2316	13.737	59.313	
		4	.2282	15.162	66.441	
		5	.2354	15.561	66.104	
IX.	Welded together near the middle—hammered till nearly black.	1	.1845	10.773	5839 5	Broke outside of welding. The strength is about the same as in No. III.

To compare this iron with others, it is proper to assume bar No. III as the standard, that having been hammered till of a dull red heat. The report already cited furnishes us with abundant data derived from experiments, made with the same machine, on other kinds of bar iron, in a similar state. Thus we have—

				Strength in lbs. pr. sq. inch.
iron from	Salisbury, Conn., by a mean of	40	trials,	58.009
"	Sweden, "	4	"	58.184
"	Centre Co., Pa., "	15	"	58.400
"	Lancaster Co., Pa., "	2	"	58·661
"	McIntyre, Essex Co., N. Y. (as above)	4	"	58.912
"	England, cable bolt (E. V.)	5	"	59.105
"	Russia,	5	"	76.069

Hence it appears that the last only is essentially superior to the iron of McIntyre. These are among the best varieties of bar iron in point of tenacity. The second class will be mentioned below.

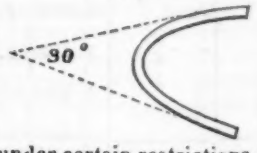
The fracture of No. I is of a light iron grey colour, silky lustre, and generally displays a compact structure. It is worthy of remark that most of the fractures took place in directions oblique to the line of tension and making with it, either in the breadth or thickness, one or more angles of about 60 degrees each.

The fibrous structure of the metal was very marked in cutting with the cold chisel and was further developed by acids on a part of No. III, on the surface of which delicate lines were shown traversing a distance of several inches. The specific gravity in the annealed state was, it appears, increased 1.2 per cent by hammer hardening.

Experiments on No. 2.

This was a bar one inch square and about two feet long. It was first bent *cold*, till incipient fracture appeared on the outer edges of the curve, which took place when the two limbs had approached so as to make an angle of 30° with each other. Fig. 4.

Fig. 4.



The exterior fibres in the part to which the change of form had been confined were then found to have a length of 7.43 inches, while those on the inside had but 4.8 inches. The difference 2.63 is to be attributed to the combined influence of compression and elongation of the interior and exterior fibres respectively, and by measuring and marking bars before and after bending them, may, under certain restrictions, be employed as a means of determining the positions of neutral axes. Changes analogous to those already observed in the form of the cross section were also remarked in the present instance.

The next trial was by turning a right angle, when hot, on a short portion of the bar and subsequently folding another part over flat upon one of its faces. All the phenomena of developing curves out of the square cross section were beautifully illustrated, and the soundness of the iron, when thus tested at a red heat, incontestably proved. A short portion of this inch square bar was heated to a fair working temperature and perforated with a punch $\frac{5}{8}$ of an inch in diameter. No signs of cracking were observed.

Four bars were prepared in all respects similar to the first four taken from specimen No. 1, and respectively treated in the same way preparatory to a trial of their tenacity. The bar marked,

V. Was completely *annealed.*
VI. " *hammer hardened.*
VII. " *hammered to a dull red heat.*
VIII. " *upset in the middle and annealed.*

As the upsetting of No. VIII had increased the thickness of that part to

which the operation was confined, care was taken to reduce by filing the cross section in the middle of the upset portion to less than that of the rest of the bar, in order to insure a fracture in metal, actually in that state. The trials on No. IV had led to the supposition of an increase of strength by the process of *upsetting*, contrary to an opinion entertained by some practical men. Experiment No 2, in the following table, on bar No. VIII, in which the fracture took place at the filed section, gives not only the highest result on that bar, but also higher than any other obtained from this variety of iron except those derived from the hammer hardened bar No. VI, and consequently confirms our previous deductions.

TABLE II.

Experiments on the tenacity of Iron in specimen No. 2.

No. of the bar.	State of the Bar.	No. of the experiment	Area of section before trial in sq. inches.	Breaking weight in lbs., avoirdupois.	Strength in pounds per sq. inch.	Observations.
V.	Completely annealed.	1	.2097	9.946.5	47.425	Length before trial 10¼ in., after trial 14.2—total elongation 30.5 pr. ct. Sp. Gr. after trial 7.680, 7.440, 7.670, mean = 7.596. Mean strength 47.328.—Greatest difference 1080 lbs. = 2.3 pr. ct. of the mean.
		2	.2121	10.146	47.836	
		3	.2131	10.146	47.836	
		4	.2132	9.975	46.785	
		5	.2237	10.459.5	46.756	
VI.	Hammer hardened.	1	.2295	12.169.5	53.026	Length before trial 10 in., after trial 12 in.—total elongation 20 pr. ct. Sp. Gr. after trial 7.608, 7.700, 7.718, mean = 7.675. Mean strength 55.657.—Greatest difference 4.569 lbs. = 8.2 pr. ct. of the mean.
		2	.2226	12.283.5	55.182	
		3	.2202	12.682.5	57.595	
		4	.2302	13.081.5	56.826	
VII.	Hammered to a dull red heat.	1	.2195	10.659	48.560	Length before trial 10 in., after trial 12.6—total elongation 26 pr. ct. Sp. Gr. after trial 7.654, 7.709, 7.712, mean = 7.602. Mean strength 49.215.—Greatest difference 2433 lbs. = 4.9 pr. ct. of the mean.
		2	.2233	10.687.5	47.861	
		3	.2154	10.801.5	50.146	
		4	.2159	10.858.5	50.294	
VIII.	Upset in the centre and annealed.	1	.2318	10.972.5	47.336	Length before trial 9¼ in., after trial 12.3—total elongation 32.9 pr. ct. Sp. Gr. 7.800, 7.827, 7.592, mean = 7.739. Mean strength 49.311.—Greatest difference 4140 lbs. = 8.4 pr. ct. of the mean. The experiments 1 and 5 on parts not upset conform very nearly to the mean of the annealed Bar No. V.
		2	.2242	11.542.5	51.484	
		3	.2317	11.913	51.415	
		4	.2430	11.941.5	49.141	
		5	.2513	11.856	47.178	

The elongations observed after the first fracture on each bar were as follows:

No. V.	In an original length of	6	in. had been elongated	.9	in.	=	15	pr. ct.
VI.	" "	5	" "	.3	"	=	6	"
VII.	" "	5	" "	.85	"	=	17	"
VIII.	" "	5	" "	.55	"	=	11	"

This variety of iron is thus seen to exhibit an extensibility by this mode of trial, rather less than that of No. 1,—the mean here being for the four bars $12\frac{1}{2}$ per cent, and for the four bars from No. 1, $13\frac{6}{10}$ per cent. But on comparing the total elongations of all the bars after fracture we find

From specimen No. 1.	No. I.	gave 35.	pr. ct.	mean 27.2.
	II.	" 20.5	"	
	III.	" 28.9	"	
	IV.	" 24.4	"	
From specimen No. 2.	No. V.	gave 38.5	pr. ct.	mean 29.3.
	VI.	" 20.	"	
	VII.	" 26.	"	
	VIII.	" 32.9	"	

From these two comparisons we may infer that there is but little difference between the two kinds of iron in regard to extensibility. From both modes of comparison, however, we are led to notice the remarkable difference between the annealed and hammer-hardened bars. By observing elongations after the first trial, we have 14.5: 5, and 15: 6, for the rates in the two kinds of iron; and by taking the total elongations, we have 35: 20.5, and 38.5: 20 for the relations. This is in accordance with what had been observed while making experiments on the strength of materials for steam boilers.

The difference in specific gravity between the annealed and hammer hardened bars from specimen No. 2, is 1.01 per cent. The iron now under consideration may be compared, in point of tenacity, with American bar iron of the second class only.

Thus from the Report before cited, we find that

				lbs. pr. sq. in.
Bar iron from	Missouri	by 22 experiments, bore		47.420
"	McIntyre,	" 4 "	on bar No. VIII (as above)	49.215
"	Tennessee,	" 21 "		52.909
"	Baltimore,	" 13 "		55.213

Assuming the strength of specimen No. 1, in each state in which it was tried as the standard, we find the following results of a comparison between the two kinds of metal above examined, viz:

Nos. I. & V. give $\frac{53.311 - 47.328}{53.311} = 11$ pr. ct. inferiority in No. 2, when annealed.

II. & VI. give $\frac{65.713 - 55.657}{65.713} = 15.3$ pr. ct. inferiority in No. 2, hammer hardened.

III. & VII. give $\frac{58.912 - 49.215}{58.912} = 16.4$ pr. ct. inferiority in No. 2, hammered to dull red.

IV. & VIII. give $\frac{63.142 - 49.311}{63.142} = 21.9$ pr. ct. inferiority in No. 2, upset and annealed.

The mean difference is 16.15 pr. ct. in favour of No. 1, or about one sixth of its total tenacity.

The fracture of No. 2, presents less of the clear fibrous texture, silky lustre, and uniform compactness, than ought to characterize an iron of the first quality.

A few general remarks seem worthy of attention in connexion with the subject of tenacity as presented by these experiments. The first is, that in the annealed state, different kinds of iron more nearly resemble each other in respect to strength, than in any other condition. This is verified by the last comparison in which the difference between the two kinds when annealed is seen to be only 11 per cent, while in the other three conditions, it varies from 15.3 to 21.9 per cent.

The *second* remark is, that in the *annealed* state, the same bar has greater uniformity within itself than in any other case. This is proved by comparing the *greatest differences*, as stated in tables I and II, in the column of *observations*.

The two *annealed* bars are there seen to give for these differences between their highest and lowest, results 3.2 and 2.3 pr. ct., mean = 2.75
The two *hammer hardened* bars gave 3.5 " 8.2 " " = 5.85
" *hammered to dull red heat*, " 4.15 " 4.9 " " = 4.425
" *upset and annealed*, " 11.2 " 8.4 " " = 9.8

The experiments on the annealed bars were, in both cases, at least as numerous as those on the *same kind of iron* in any other state, and hence, other things being equal, ought to have presented at least equal discrepancies; while in fact these are scarcely more then one half as great as the *least* of the others, and are less than one third as great in *either instance*, as those found in the *upset and annealed* bars.

The *third* observation I would make is, that in upsetting part of a bar and subsequently annealing the whole of it, the differences between different kinds of iron, and between the several parts of the same bar, are both at a maximum. The two varieties of iron gave a difference of nearly 22 per cent. from each other, and their mean diversity for the same bar is 9.8 per cent. of its mean strength. This may satisfactorily be explained only on the supposition that upsetting iron *increases* its direct cohesion, since we know that annealing *diminishes* it, while the structure is thereby rendered more uniform.

Our next remark is that between the *ordinary* and the *hammer hardened* state of No. 1, there is a difference in tenacity of 11.7 per cent. of the strength in the former condition; and that for No. 2, this difference amounts to 13 per cent. The English cable bolt iron above mentioned, manifested a difference of 20 per cent. under similar diversity of treatment. The difference between the tenacity of No 1 when annealed, and that when hammer hardened is 23.3 per cent, of the strength when annealed; and for No. 2 this difference is 17.6 per cent. Now as we have already proved that *hammer hardening* diminishes the extensibility of a bar, it must follow that *stiffness as well as strength is essentially augmented by this treatment.*

It may be further remarked that by 13 trials the stronger variety of McIntyre iron had a specific gravity of 7.728, and by 12 trials that of the weaker kind was found to be 7.676, the difference .052 being = .6 of one per cent, and that the mean specific gravity of other kinds of bar iron formerly tried was found by 17 trials to be 7.725. The Russian iron above mentioned had by the mean of 10 trials on separate portions of the same bar a specific gravity of 7.801, the highest being 78.702 and the lowest 77.586. These facts, in connexion with the increase both of strength and specific gravity by hammer hardening appear to favour, though perhaps they do not establish,

the supposition that *whether from chemical constitution or from mechanical treatment, a deficiency in specific gravity is an indication of inferiority* in the strength of iron. I am aware of some apparent exceptions to this rule.

In conclusion it may be observed that the great amount of much worse iron which finds its way into the American market, will render even the McIntyre iron No. 2, an object worthy the attention of the consumers of this article. But as a large and an increasing demand for good iron prevails in the United States, in proportion to the increase of finished and accurate machinery requiring superior materials as well as workmanship, there can be no doubt that any quantity which could probably be produced, if possessing the properties of No. 1, would command a ready market and the best of prices.

Civil Engineering.

Some remarks on the Internal Improvement System of the South, by JOHN C. TRAUTWINE, Engineer in Chief of the Hiwassee R. R.

WITH A MAP.

For some time after the introduction of rail-roads into our Union, their construction was confined almost exclusively to the northern states. To Pennsylvania is due the credit of having been foremost in the cause of state rail-roads, as she had before been in that of state canals. She has, through either her Legislature, or chartered companies, expended the heavy sum of thirty millions of dollars, in works more or less intimately connected with internal improvements. Large expenditures had also been made in Maryland, Delaware, New Jersey, New York, the New England states, and Virginia, for a considerable time before the importance of the internal improvement system appeared to manifest itself to the more southern portion of the Union; and with, I believe, the single exception of the South Carolina rail-road in 1830, but little or nothing of importance had been done to further its advancement, until within the last 3 or 4 years.

The river Ohio (see accompanying map) in connexion with the improvements of New York and Pennsylvania, has hitherto been the great thoroughfare along which merchants of the west and interior have sought the markets of New York, Philadelphia, Baltimore, and other northern Atlantic cities; and along which they have in return transported to their several states, the goods purchased in those cities. South of the Ohio, they have never had offered inducements to visit the southern ports. Five or six hundred miles of miserable roads, nearly impassible in winter, have effectually shut out all intercourse between the merchants of the west and the Atlantic seaports of the south. The only rival of the northern cities in the trade of the north western states, and of the interior, has been New Orleans; to which an easy access is had down the Mississippi river. But even there the trade has been confined principally to groceries, of which the sugar and molasses manufactured near New Orleans, constitute the principal items. As respects merchandise, the sales there are principally made to retailers, living along the banks of the river, who send down produce to New Orleans, and receive return loads of groceries and merchandise in exchange. The *wholesale* merchants even along the Mississippi river, and of the states of Mississippi, Alabama, Georgia and Tennessee, as well as those of the north western states, make their purchases in the northern cities; which in the sale of all articles of European manufacture, enjoy almost an exclusive monopoly.

This is owing in a great measure to the superiority of the navigation between them and Europe, over that between New Orleans and Europe. Not only is the voyage to New Orleans the longer by more than 1000 miles, but it is rendered comparatively dangerous by the intricate passages, and obstructed navigation of the Bahama banks and capes of Florida.*

This objection, however, does not apply to the cities of the southern Atlantic sea board. The navigation from Europe to Charleston and Savannah, is at least as good, if not better, than that to the northern cities. Moreover the south would have a very important advantage over the north, in the mildness of her climate, which would allow merchants to transport their goods at all seasons, without fear of obstruction from ice. Serious delays occur annually in the northern canals, from this cause. Let the south then open for the merchants of the west and interior, as good avenues to her seaports, as the cities of the north have done to theirs, and the monopoly of the latter must at once cease, and the south become a heavy importer. This she has finally resolved to do.

Within the last few years, the confidence which had been awakened in the south, by the increasing number of our northern projects, gradually became stronger; and as the success of these projects by degrees revealed itself in the realization of handsome profits, finally was confirmed. Thus experimentally convinced of the immense benefits resulting to the Atlantic cities of the north, from their numerous channels of intercourse with the west, she determined that she also would enjoy them.

This determination was promptly followed up by suggestions for various lines of rail-road, stretching from the principal Atlantic cities of the south, to the interior of our Union; where their upper extremities are to be united to the lower termini of other lines, now being constructed in the north western states of Indiana, Illinois, and Ohio, by which they will be extended even to the great lakes.

Through these connected lines of rail-roads, the merchants of the west will have as easy access to the seaports of the south, as to those of the north. The former will thus be enabled to effect an extensive importing system, and the heavy trade now monopolized by the north, will be distributed more equally along our entire sea board.

A strong impulse has been given to the southern improvements by the lively interest taken in many of them, by the several states through which they pass; the consequence of which judicious policy is, that almost every individual state south of the Potomac and west of Pennsylvania, is at this moment engaged in forming its respective link in the grandest chain of internal improvements ever suggested; and one which will in less than six years from this time, effect an almost magical change in the commercial relations of the various sections of our country.

Fortunately for the south, she has conducted her operations thus far, with a spirit of unity and concert, much more marked than that which characterised the northern projects. Her several districts, sensible that the prosperity of each depended on its means of ready intercourse with all the others, are

* Might not this difficulty be remedied in some measure, by the construction of a ship canal across the Isthmus of east Florida? Its length would probably not exceed 80 miles, and the country is very favourable for its construction. That common objection to canals, viz. their liability to obstruction by ice, would not apply here, owing to the mildness of the climate; the voyage would be greatly shortened and the most difficult and dangerous portion of it entirely avoided. This is one of the few instances in which we consider a canal *infinitely* preferable to a rail-road. WRITER.

constructing their respective lines with a view not only to the effecting of *local* considerations, but to the accomplishment of a magnificent project of *National* importance.

The most striking feature in the commercial aspect of the south, is her *Cotton growing.* The cotton country includes South Carolina, Georgia, Alabama, Mississippi, middle and west Tennessee, and large tracts west of the Mississippi river. The great demand for this article over the whole globe, renders its cultivation far more profitable to the southern landholders, than that of the common agricultural products would be. Consequently the cotton country is devoted almost exclusively to its culture; a small proportion of rice constituting nearly the only exception. The cotton is pressed and put into bales at the place where it is grown; and thence sent by land to the nearest navigable stream, down which it is transported, principally in steam boats, to the various southern ports.

The business of most of the flourishing towns of the south, depends very essentially upon the receiving and exporting of cotton; all other things remaining as at present, many of them would probably cease to exist, with the demand for that article.

It follows from this general neglect of the farming interest, that the southern population must depend upon other sections for supplying them with provisions. These they receive from the interior and north western states; but especially from Kentucky and east Tennessee, both of which districts, in point not only of agricultural, but of mineral and manufacturing resources and facilities, are excelled by no other portions of the Union.

From them, immense droves of live stock, and heavy amounts of provisions are annually sent to the cotton country, where the great distance and the wretched condition of the roads cause them to sell very high. On this account provisions command greater prices in the southern sea ports than in any other part of the United States; and as the badness of the roads and the great length of hauling necessary, will not admit of an exchange for merchandise, the sales are almost always for *cash;* of which large sums are thus annually transferred from the south to the interior and north western states. When the southern rail-roads shall be completed, this draining of cash from the cotton country, will in a great measure be counteracted by the sales of merchandize to the western merchants.

As before remarked, the universal demand for the staple product of the south, enables the southern seaports to do an immense *exporting* business. The raw cotton is from them shipped principally to Liverpool; and in England, that great manufacturing district for the whole globe, it is made up into goods, and in that state sent to every quarter of the earth.

A great quantity returns to this country; but not as one might at first suppose, to the *southern* sea ports, from which the raw material was exported; it returns to the sea ports of the *north;* because there the merchants of our immense interior congregate to make their purchases; and thus ensure a constant market.

But *why*, it will be asked, do the merchants of the interior prefer the sea ports of the north, to those of the south? The answer is simply this, *because the roads are better.* The cities of the north have by a judicious system of internal improvements, opened for the western merchant, easy routes to reach their markets; and safe and speedy ones for carrying his purchases home. While Baltimore, Philadelphia, and New York have been contending with each other, for the supremacy, by each trying to excel the other in her channels of intercourse with the west, the south has stood idly by

and done nothing. She has been content to permit not only the merchants of the interior, but even *her own, those residing in her own sea ports*, to purchase their goods in the northern cities.

She forgot that the opening of every fresh avenue to the *north*, was the obstructing of one *to her;* and heartily joined in congratulations at the increasing prosperity of her sister, unmindful that it was secured at her own expense. "Better late than never," is a good old saying; and upon its inculcations has the south at last begun to act. She has commenced, and is now energetically pushing forward, a system of rail-road improvements, which will soon present to the merchant of the interior, inducements to visit her sea ports, as well as those of the north; and by purchasing his goods there, enable her to open a direct *importing*, as well as *exporting* trade, with the other continent.

But even with the manifold benefits which must result to Charleston and Savannah, from the completion of their rail-roads to the interior, we can not, with many of our southern friends, look for those cities ever to attain the size and commercial importance of New York or Philadelphia. From the very nature of the staple (cotton), which requires comparatively few landholders, it appears to us impossible that the population of the south can ever become so dense as that of the north; and the magnitude of a market, must depend upon the number of purchasers. A large cotton grower can easily cultivate 1500 acres; while our wealthy northern farmers, rarely hold more than 500; and perhaps the majority do not exceed 250. Besides this, the inexhaustible mineral resources, the manufacturing and agricultural advantages, the more equal distribution of wealth, and I may add, the more stirring and industrious business habits incident upon the colder climate of the north, all combine to render her cities more affluent than those of the south.

Still shall the south have attained that great desideratum, a termination of her mercantile dependence on the north. Her rail-roads will enable the merchant of the interior to purchase his goods alike in New York, Philadelphia, Charleston or Savannah, as either may, from fluctuating causes, offer the best market. Instead of the heavy cash purchases of stock and provisions now necessary, an exchange of these articles for merchandise will be effected, and Savannah and Charleston will in a few years have attained an importance, with which their present condition will admit of no comparison.

But shall we permit the foreboding politician to predict from this termination of commercial dependence, a cessation of national dependence, of national feeling? Far from it. Community of intercourse will annihilate our local prejudices, will bury in oblivion the differences of by-gone times, and draw the bonds of union more close than ever.

We will now pass on to the consideration of the several lines of rail-road by which the south hopes to accomplish the grand object in which she has embarked.

A reference to the map will show that Illinois, Indiana, and Ohio are constructing several rail-roads from their respective interiors, to the Ohio river; it will show, moreover, that they are constructing some of them in such directions, that, by uniting, they will form *a continuous and very direct line of rail-road from the "Far West," passing through Cincinnati to the* Northern Sea Ports;—*and thirdly, it will show that from Cincinnati to Philadelphia by this line of rail-road, is a shorter distance than from*

Cincinnati to Charleston, by way of the Charleston and Cincinnati rail-road.

We wish these facts to be distinctly borne in mind by the reader, as we shall soon have occasion to bring them forward in support of some opinions of ours, which are opposed to those of many persons in the south, and therefore require strong arguments to sustain them.

First in importance, magnitude, and splendour of conception, of the several projects for benefiting the south by the effecting of an importing system, is the great Charleston and Cincinnati rail-road. Commencing (see map) at Charleston, this road occupies the line of the old South Carolina rail-road, as far as Branchville, 62 miles, thence it continues to Columbia, a further distance of 66 miles; thence to the North Carolina line, by a route not yet finally determined on, about 150 miles more; thence to Ashville, N. C., 41 miles; thence to the Warm Springs, 36 miles; thence along the valley of the French Broad River to Knoxville, 100 miles; (or 455 miles from Charleston to Knoxville); from Knoxville it passes on through Lexington to Cincinnati by a route not yet finally adopted, about 265 miles; in all about 720 miles.

The company for constructing this road, is chartered by the four states through which it passes; viz. South and North Carolina, Tennessee, and Kentucky. Three of them, viz. North and South Carolina and Tennessee, have also granted banking privileges; Kentucky has not yet, but probably will do so this winter. South Carolina and Tennessee have also rendered pecuniary assistance to the road; North Carolina and Kentucky have not.

Independently of the tendency of this project, considered merely as a *rail-road*, great and beneficial results are to be hoped for, from its *banking powers*. The late derangement of the money market, has plainly pointed out the necessity for a circulating medium, based on other than restricted local credit; and such a medium the Charleston and Cincinnati Company will certainly effect, *in case the rail-road be completed.*

But if this be not done, we cannot see how the interest of the states through which it is to pass, can be enlisted in its cause; the circumstance alone of its *being chartered* by four states, cannot, it appears to us, prevent it from dwindling down into a mere South Carolina bank, with an influence and credit far less extensive than those of the present United States Bank, of Pennsylvania. To prevent this it will be necessary for Tennessee and Kentucky to lend themselves freely to the work. What has already been done is too trifling, in comparison with the magnitude of the project, to deserve a moment's consideration; it is for all practical purposes only *nominal.* We hope soon to see those two states awakened to a due appreciation of the utility of the undertaking, and embark largely in it.

It will be seen on the map, that *from the city of Knoxville in Tennessee, there are laid down two continuous lines of rail-road to Charleston, S. C.*, one of these may be called the *northern* or *upper route*, and the other the *southern* or *lower route.* The upper one is that selected by the Charleston and Cincinnati Rail-road and Banking Company; its length (as just now shown) from Knoxville to Charleston is 455 miles. The lower route consists of a chain of several distinct rail-roads, commencing with the *Hiwassee Rail-road*, 98¼ miles in length, which extends from Knoxville to the dividing line of Tennessee and Georgia; where it unites with the *Western and Atlantic Rail-road*, which continues 118 miles, to near Decatur in Georgia; thence the line runs to near Crawfordville 58 miles; thence by the Georgia Rail-road to Augusta, 65 miles, thence by way of the South Carolina Rail-road

to Charleston, 136 miles, in all 475½ miles. From Crawfordville to Charleston 201 miles is already completed and in full operation; and between Crawfordville and Knoxville the line is now being graded with great energy. These two lines (the upper and lower) differ very materially in their characters, the upper route being the shorter by 20½ miles; but the lower possessing so great a superiority in point of levels and curves, as will, by admitting of greater speed, enable the trip to be made on it in less time than it can on the upper route.

The lower route affords the entirely unprecedented fact of a continuous chain of rail-road, nearly 500 miles in length, carried principally through a mountainous country, yet nowhere presenting a grade exceeding 36 feet to a mile; and at the same time unincumbered by tunnels or inclined planes.* Its shortest radius of curvature is 1000 feet; and even *it*, if we mistake not, occurs only on the Western and Atlantic Rail-road; on the Hiwassee Rail-road the minimum radius is 1400 feet, and occurs but twice; both being at the crossing of heavy ridges, and at the same time stopping places; on the other sections of the lower route, there is no radius under 1900 feet.

Even the minimum radius of 1000 feet, will with proper attention to details, admit of a speed of 20 miles per hour, with perfect safety; and this may, without fear of error, be assumed as *the least average speed* of the passenger trains, on the lower route; one of from 25 to 30 miles an hour, could readily be attained if necessary.

Each section of the lower route also presents nearly the same maximum grade, varying in none more than 3 or 4 feet; the maximum rise, as before remarked, being but 36 feet in a mile. This uniformity will admit of extreme regularity in the business operations of the several sections.

The wonderfully favourable character of the lower route is incident on the fact, that it occupies a series of vallies, running parallel to the immense mountain barriers, which nature has stretched as if in defiance of the efforts of art, almost uninterruptedly, from New York to the northern parts of Georgia. At the latter point we are enabled to curve round their lower extremities, and thus reach the sea board without crossing them.

On the other hand, the upper route is necessarily carried *across* these barriers, and must therefore encounter the heavy grades incident upon approaching them, and either the deep cutting, inclined planes, or tunnels, required for overcoming their summits.

Again, certain portions of the upper route, such as the deep valley of the French Broad River, and various mountain passes of the Blue ridge; are annually obstructed for several weeks by snow, ice and frost. This will create serious, if not *insurmountable*, obstacles to regularity in the winter business; especially as the thinly scattered population of those parts, will not admit of the collecting of large forces of men to clear the road, as is frequently found necessary in the north.

On the lower route, ice and snow rarely occur at all; and *never* in sufficient quantity to cause a moment's interruption to rail-road traveling.

Again, the cost of the lower route will be so small in comparison with that

* There is, it is true, one inclined plane on the South Carolina Rail-road, a few miles from Augusta; it was incurred when that road was first constructed, to gratify the inhabitants of the little town of Aiken. The extension of the road, as now taking place, was not, at that time, thought of; and as the business incident on the extention gradually increases, the plane will no doubt be dispensed with. Fortunately this can be very readily done.

of the upper, that it will be absolutely impossible for the latter to maintain a competition with it. Thus we see that in point of all the desiderata of rail-road traveling, in speed, safety, certainty, and cheapness, the lower route is, by far, preferable to that selected by the Charleston and Cincinnati Rail-road Company.

I have been thus particular in comparing the upper and lower routes from Knoxville to Charleston, that I might with the more apparent reason, urge upon the advocates of the Charleston and Cincinnati Rail-road, the *immediate* construction of that portion of their road which lies *between Knoxville and Cincinnati.* The present intention of the company appears to be to construct the road gradually from Charleston upwards towards Knoxville, and thus on to Cincinnati; leaving, of course, the part between Knoxville and Cincinnati, some years behind the portion through South Carolina. Now it is very evident that a rail-road from Charleston, through the centre of South Carolina, even if it stop at the northern line of the state, will be of immense benefit to South Carolina, and particularly to Charleston; it will furnish an excellent communication between the interior of the state and her sea board; and this is very important to *her;* but is it important to the *stockholders?* Is it calculated to excite in Tennessee, Kentucky and the whole Union, the confidence which a rail-road from Charleston to Cincinnati was designed to effect? Why should a merchant, residing at a distance from the line, prefer a note of the South Carolina Rail-road bank, to that of any other rail-road; and into a mere South Carolina Bank must the whole scheme degenerate (at least for several years,) if the present intention be persisted in. And pray of what benefit is a line from Charleston to Knoxville to be at any rate, toward effecting an importing system, even supposing both the upper and lower routes to be completed thus far? Let us imagine for a moment that such were the case, and that the interval between Knoxville and Cincinnati remain as at present, traversed only by miserable common roads; can any man suppose that either route, or even their combined attractions, would operate to the value of one farthing, in diverting the trade of the "Great West" from along the Ohio river to the northern sea ports, and turning it towards Charleston? Can he suppose that one merchant more would come from Illinois, Indiana, or Ohio, in consequence of it? Assuredly not. What is to induce the western merchant to exchange the splendid and cheap accommodations, the speed and comfort of his steamboat as he passes up the Ohio, for a rough, unsafe and expensive stage ride of some 200 or 300 miles by day and night, at 2½ miles per hour to Knoxville? Is it the love of adventure, in risking his life over the perilous mountain passes of Kentucky and Tennessee? I trust not, yet can I conjure up no better reason.

I hesitate not to predict that if the Charleston and Cincinnati Railroad Co. delay the construction of their road from Knoxville to Cincinnati, until after the completion of the remainder, the trade of the Great West will have become so fixed in its channel of the Ohio, and the line of rail-roads before alluded to, parallel to that river, that the South will endeavour in vain to change it. Let her even *do her best*, the lines through Indiana, Illinois, Ohio, Pennsylvania and New York, will be completed before she can make the road from *Knoxville to Cincinnati.* What madness is it then to delay. While we are hesitating and discussing whether the upper or lower route *from* Knoxville to Charleston, be the better, we seem to forget that we have provided no means for bringing passengers and merchandize *to* Knoxville;

and while, like the wolf and the bear, we are disputing for the prey which lies before us, a third party steps in and carries it away from both.

The course pursued in this matter by South Carolina, upon whose movements the whole machinery of the scheme depends, is by some ascribed (it appears to us uncharitably) to an existing jealousy between her and Georgia; by which South Carolina is supposed to be actuated to such an extent, as to decline all interference in any project in which Georgia should take part; and consequently prefer making an expensive road through her own territory, to availing herself of one of far superior character, through her rival State. Thus we see the upper end of the Charleston and Hamburg rail-road, and the lower end of the Athens and Augusta rail-road, like the two ends of a horse-shoe magnet, (see map) exercising a repulsive influence on each other, which bids fair to neutralize the otherwise general and beneficial action of this noble scheme.

To us it appears that the policy for South Carolina would be to enter into an amicable arrangement with the various companies constituting the lower route from Knoxville to Charleston, (of which route she already possesses 136 miles, in the Charleston and Hamburg rail-road;) and then construct the line from Knoxville to Cincinnati. By concentrating all her energies upon this interval, she would beyond all doubt, enlist both Tennessee and Kentucky deeply in the enterprise; for to both of those States, it is one of great importance; but so long as the present policy of working from Charleston upwards through South Carolina, is adhered to, the benefits of the undertaking are far too prospective, to induce any active interference in its behalf, on their part.

To adopt the course we propose, would probably lose to the company the charter of North Carolina; as the line would, in that case, not enter her territory. But of what importance is that consideration? Of what benefit is the Charleston and Cincinnati rail-road to be to North Carolina, in any event? It passes only through one of her counties, and that her extreme western one, and of a most sterile and mountainous character. Surely that is not sufficient to induce a hope that North Carolina will render any important aid to the project; whereas in the other case, as before said, both Tennessee and Kentucky would assuredly assist it to a very efficient degree; for both these States would need it for the exportation of their live-stock and provisions to the cotton country; and that alone, independently of any considerations of a southern importing system, should be a sufficient guarantee of profit, to warrant the immediate construction of the road through those two States.

We cannot anticipate much difficulty in procuring from the Legislatures of Tennessee and Kentucky, permission so to alter the charter, as to admit of the changes we propose. Legislative bodies, like private individuals, are influenced by *interest;* convince them that their present course is detrimental to their interest, and they will assuredly change it.

Perhaps the greatest real difficulty in way of the change lies in the company itself, not being willing to have its concerns divided into two branches, as would be the case if our ideas of uniting the Charleston and Cincinnati rail-road with the *lower route*, should be carried into effect. The Charleston and Cincinnati rail-road Company would then own only the road already constructed from Charleston to Augusta, and that, yet to be commenced, from Knoxville to Cincinnati; the interval between Augusta and Knoxville being in possession, as already stated, of several distinct companies.

Could the Charleston and Cincinnati company purchase this interval from

the various companies now holding it, the difficulty would be at once removed; but we consider such an arrangement so utterly impracticable, that it is useless even to suggest it.

Great as the objection certainly is, to the division of the concerns of the Company, still it is obviously not an insuperable one. The case seems to us, nearly parallel to that of a merchant possessing flourishing business houses in two different cities.

Be that as it may, however, we cannot view the construction of the upper route from Knoxville to Charleston in any other light than that of a useless expenditure of money, unless it be looked upon as politic to purchase the good will of the districts through which it passes, by circulating among them at the expense of the company, the sums requisite for its construction. Even if finished, *it can never sustain a competition against the superior merits of the lower route.*

We are somewhat surprised at the course pursued by Kentucky in relation to the Charleston and Cincinnati rail-road. She has lent no pecuniary aid to its construction, although she must necessarily derive great advantages from it. Her merchants will be provided with new markets for making their purchases; and the facilities for conducting her heavy exports will be greatly increased. The road will certainly not be made through Kentucky, unassisted by her pecuniary means; it is therefore to be hoped, not only on *her* account, but in a *national* point of view, that her opinions on the subject may assume a more favourable direction. We cannot but suppose that the adoption of the lower route, would lead to such a change, and enlist Kentucky strongly in the cause.

We have hitherto spoken principally of *Charleston*, as striving to carry out measures for diverting part of the trade of the west, from the northern to the southern sea ports, by means of her rail-roads; we must now speak of her enterprising and spirited rival, Savannah. In point of magnitude Charleston is greatly superior to Savannah, containing a population of 43,000; while that of Savannah is but 10,000. The principal distinctive feature however between the two cities, as regards their importing facilities, consists in the superior harbour of Charleston; which is, we believe, confessedly the best along the Southern Atlantic sea-board.

There will however be no means left unresorted to, for rendering that of Savannah, in every respect perfectly eligible, and this its natural position admits of the more readily, since constructions in that branch of engineering are no longer involved in the uncertainty, by which, until the discoveries of late years, they were characterized.

It will be perceived by the map, that Savannah is determined to be by no means behind Charleston, in her facilities of intercourse with the interior and north western States; indeed if Charleston persevere in her scheme of the upper route from Knoxville, and insist upon conducting her transportation along it, Savannah will have the advantage of a far superior road; which, in our opinion, will much more than counterbalance any disparity which may exist between their respective harbours.

On the map is marked a rail-road from Savannah to the city of Macon, near the centre of Georgia. This is the great *central rail-road of Georgia*; its length is about 200 miles. It is exclusively a company work. About 80 miles of it are already finished and in use; and the remainder is being rapidly progressed with. Like the lower route from Knoxville to Charleston, it is characterised by its unusually favourable features; and indeed the same remark may be applied to all the rail-roads in Georgia.

From the city of Macon the rail-road is continued to the town of Forsyth, by the Monroe rail-road, twenty-four miles in length; which will soon be (if it is not already) in operation.

From the city of Macon, is also to be constructed another rail-road to the town of Talbotton; at which point it will branch off into two lines: one to West Point, to meet the Montgomery and West Point rail-road; and the other to Columbus. Another branch from the Central rail-road is also being surveyed, through the town of Waynesborough to Augusta, by which a union will be effected with the lower route from Knoxville. It will be forty-eight miles in length. Thus it will be seen that Savannah possesses quite as favourable avenues to the interior, as Charleston does; and if a bridge be not built across the Savannah river at Augusta, by which the South Carolina rail-road may unite with the lower route from Knoxville, Savannah must receive the preference from western merchants. We are fully convinced that the want of a bridge at Augusta, and the selection of the upper route, by the Charleston and Cincinnati rail-road company, will do more to decide the question of superiority between those two rival cities, than any other consideration possibly can.

About 70 miles south of Savannah is the sea-port of Brunswick; at present a place of comparatively little importance; but destined, on account of its remarkably fine harbour, and its contemplated rail-road connexion with Savannah, to become in a short time one of the most important of the southern ports.

Besides these Atlantic ports, others on the gulf of Mexico, such as Appalachicola, Pensacola and Mobile will become termini of rail-roads from the interior; and will all be more or less similarly affected with Charleston, Savannah and Brunswick; with, however, this great difference, that the dangerous navigation of the Bahama banks at the mouth of the gulf of Mexico, which must be encountered in a voyage to, or from, Europe, will always keep them secondary to the Atlantic ports. As before remarked, we think this might be obviated by a ship canal across East Florida; or, more imperfectly, by a rail-road.

Appalachicola is at the mouth of the Appalachicola river, formed by the confluence of the Flint and Chattahoochie. The latter is navigable for steam-boats for 200 miles as far as Columbus; from which point, as indicated by the map, are lines of rail-roads to Cincinnati by way of Knoxville; and also to Savannah and Charleston. At this time, Appalachicola is but a small town; it receives considerable amount of cotton from the upper parts of Georgia, by way of the river, but its importance will be increased greatly by its rail-road connexions.

Similarly conditioned with Appalachicola, are Pensacola and Mobile. We have not in our possession, any very definite information respecting the rail-road from Pensacola to Montgomery; we believe however that some progress has been made in its construction. From Montgomery, or rather from Fort Mitchell, (a point some distance above Montgomery) to West Point, is a rail-road in a state of rapid progress. The reason for delaying the construction between Fort Mitchell and Montgomery is, that the river navigation between those places, although very circuitous, is sufficiently good for present purposes. The prolongation to Montgomery, will be made, as soon as the progress of the Pensacola rail-road, renders it advisable.

Through West Point passes also the Columbus and Chattahoochie rail-road, leading from Columbus, to the western and Atlantic rail-road, near

Decatur. This latter road will, like the Montgomery and West Point rail-road, be rapidly pushed forward to completion.

The intercourse of Mobile with the interior, will be both through the same channel as that to Pensacola, and also through the *Selma and Tennessee rail-road*, now under construction from the town of Selma to the Tennessee river, above Huntsville. This road is 170 miles in length. A branch is contemplated from near its upper terminus, along the valley of the Coosa river, to join the western and Atlantic rail-road, near New Echota. This branch will open to Alabama a communication to East Tennessee, by way of the Hiwassee rail-road, to Knoxville; and thence by way of the Charleston and Cincinnati rail-road to the Ohio; it is very important to all Alabama. We have heard of no contemplated branch from the Selma and Tennessee rail-road to Tuscaloosa; but such a one will assuredly soon urge itself upon the public notice, in that section. The harbour of Mobile bay at the town being too shallow for large ships, and gradually becoming worse, it has been found necessary to construct a rail-road 28 miles in length to Cedar Point on the gulf, where the largest vessels lie in safety.

From the town of Wetumpka, above Montgomery, a rail-road is in progress, along the Valley of the Coosa to Fort Williams; by which the obstructions in the river between those points, will be avoided. It is called the Coosa and Wetumpka rail-road; and will be extended to unite with the Selma and Tennessee rail-road, and with the lower route from Knoxville to Savannah and Charleston.

All these roads are constructed with the triple intention of expediting the carrying of cotton from the interior, to the several ports at which they terminate; of procuring provisions more readily from the agricultural districts of Tennessee and Kentucky, &c. and of effecting an *importing system in the South.* The rivers of the South, answer the purposes of intercommunication in but a very imperfect manner. In the summer they generally become unnavigable, for want of water. It is well known that the Ohio trade is interrupted more or less every summer, from this cause; but in the streams still further South, the deficiency is felt to a much more serious extent. Thus the Tennessee river, *even in the most favourable seasons* is rarely navigable for steam-boats, even of moderate draft, for more than two or three months in the year, as far up as Knoxville; and we have known intervals of very nearly a year to elapse, without a sufficient rise of water, for a single arrival. Pretty much the same, only not to so great a degree, may be stated of the river Cumberland, and the city of Nashville. The delays thus occasioned are extremely vexatious, and frequently productive of great inconvenience to the merchant.

We will remark while speaking of Nashville, that we expect soon to see her interesting herself in the construction of a rail-road, to meet the Western and Atlantic rail-road near Ross' landing on the Tennessee river. The Western and Atlantic rail-road, it will be seen by the map, branches into two lines, near its northern terminus; one going directly north, to meet the Hiwassee rail-road; and the other passing in a north-west direction, to the Tennessee river, near Ross' landing. A communication between the latter branch and Nashville, would relieve that city from the embarrassments of the obstructed navigation of the Cumberland. Such a road, in connexion with the Hiwassee rail road, would constitute the best route between Nashville and Knoxville; it would be but a very few miles longer than the present stage road between those places. Its length would be about 100 miles.

Again, in order fully to perfect the importing system of the South, a ready communication is obviously necessary between her sea-board and the region west of the Mississippi river; as well as with the north-western States. Such a communication is in progress. It is marked on the map, extending from the upper terminus of the Selma and Tennessee rail-road, to Memphis on the Mississippi. Of this very important line, the portion between Decatur and Tuscumbia (43 miles) has long been in operation; and that from Lagrange to Memphis, constituting the Memphis rail-road, 50 miles in length, is in progress. The intervening spaces have not yet been commenced; but undoubtedly soon will be. It will be one of the most useful and lucrative lines in the Union. We look for much more of the Illinois trade with the Southern Atlantic ports to take this channel.

Before closing this paper, we cannot refrain from making a few remarks respecting Virginia and East Tennessee.

It is a common observation, that Virginia is behindhand in her internal improvements, and that she is not equalling her sister States in energy, and foresight. For ourselves we cannot subscribe to that opinion; the remark appears to us an unjust one. Virginia has already done much, and is still steadily progressing in a very extensive and costly system of improvements. To enumerate them would be foreign from our present purpose; we will only urge upon her the necessity of one more. We allude to a rail-road from either Winchester, or Richmond, passing through the State in a south western direction, through Wythe Court-house and Abington, to meet an extension of the Hiwassee rail-road, at the Tennessee line near Blountville. This will form part of the *shortest and most eligible route from Maine to New Orleans, that can be obtained in the Union.*

Surveys have been made for the line from Richmond, and were favourably reported on; but unfortunately the requisite appropriations were not made for prosecuting the work. There can, however, be little doubt that the efforts which will be renewed at this session of the Legislature, will be successful. We consider the question one of immense interest to Virginia. Her fertile and far famed valley has long been retrograding, for want of an outlet to markets, which would permit it to enter into competition with more successful candidates.

This portion of Virginia has depended very much for sales of produce, upon travellers, and upon the wagoners who haul into the interior the merchandize purchased in the northern cities. The traveling has gradually been diverted into other, and better, channels; and even the hauling of merchandize, is at the moment we are writing, about to give way to more expeditious and economical channels opened by the rail-roads, constituting part of the lower route from Knoxville to Charleston; and which is now finished from Charleston northwards, upwards of 200 miles. By this route goods may be shipped from the northern cities to Charleston, and thence forwarded by rail-roads and wagons to East Tennessee, at a less expense than they can be hauled far across the valley of Virginia. No further reasoning is necessary, (though much more could be adduced) to convince Virginia of the necessity of prompt measures in relation to this road. Tennessee will readily co-operate with her, by filling up the interval between Knoxville and Blountville; and thus open an *uninterrupted line of rail-road from Maine to New Orleans.*

In East Tennessee, the reader will perceive that the Hiwassee rail-road occupies a position peculiar to itself, and one of the utmost importance to all interested in it; viz. it is at the same time a portion of the great line

from the N. E. to the S. W.; and of that from the S. E. to the N. W.; in other words, it is the *great cross road of the union.*

The numerous mountain ranges which occupy the region extending for 200 miles on each side of it, forbid the construction of a rival road; and ensure to the Hiwassee rail-road two sources of income, either of which would alone be sufficient to warrant its construction.

This is the case, we believe, with no other rail-road in the country; and it offers to the stockholders, the best inducements to believe in the full success of their project.

We must now call the attention of capitalists and farmers, to the eastern section of Tennessee. We are certain we are within bounds, when we say that no portion of our Union presents more flattering prospects of a profitable investment in every department of manufactures and agriculture, than East Tennessee.

She is the *nearest competitor* to the cotton growing country, in the sale of provisions and stock; her fertile vallies ensure abundant returns to the husbandman; her delightful climate is the most healthy in the Union; avoiding alike the extreme warmth of the South, and the extreme cold of the north. Her mineral resources of iron, lead, lime, gypsum, salt, coal, marble, &c. are inexhaustible. Her water power is unlimited and scattered over every part, to a most unusual degree; and finally a dense population is ready to insure success to the establishment of every kind of manufactory, and full employment to the mechanic in every department.

East Tennessee has hitherto held a peculiar position; hemmed in on all sides by mountains which almost preclude access, her merits have been overlooked. In other parts of the Union she is almost unknown; we may freely venture to say that no portion of the Union is so little known to all the others, as East Tennessee; yet she occupies the very centre of them all. The same cause which has operated so powerfully to retard the growth of Charleston and Savannah, has exerted the same influence on East Tennessee, viz. *the want of good roads.*

These she is now engaged in making; and in a very few years she will burst upon the notice of her sisters, with almost as strong claims to novelty as a newly discovered country. JOHN C. TRAUTWINE.

Knoxville, Nov. 1838.

Note—The above is to be regarded as but a very cursory and imperfect sketch of the Southern Improvement System. Our object being merely to lay before the reader, some of its most important bearings.—*The Writer.*

l Engineer.
N PIPES.

	1869.81	9.53	1795.45	7.	1380.80

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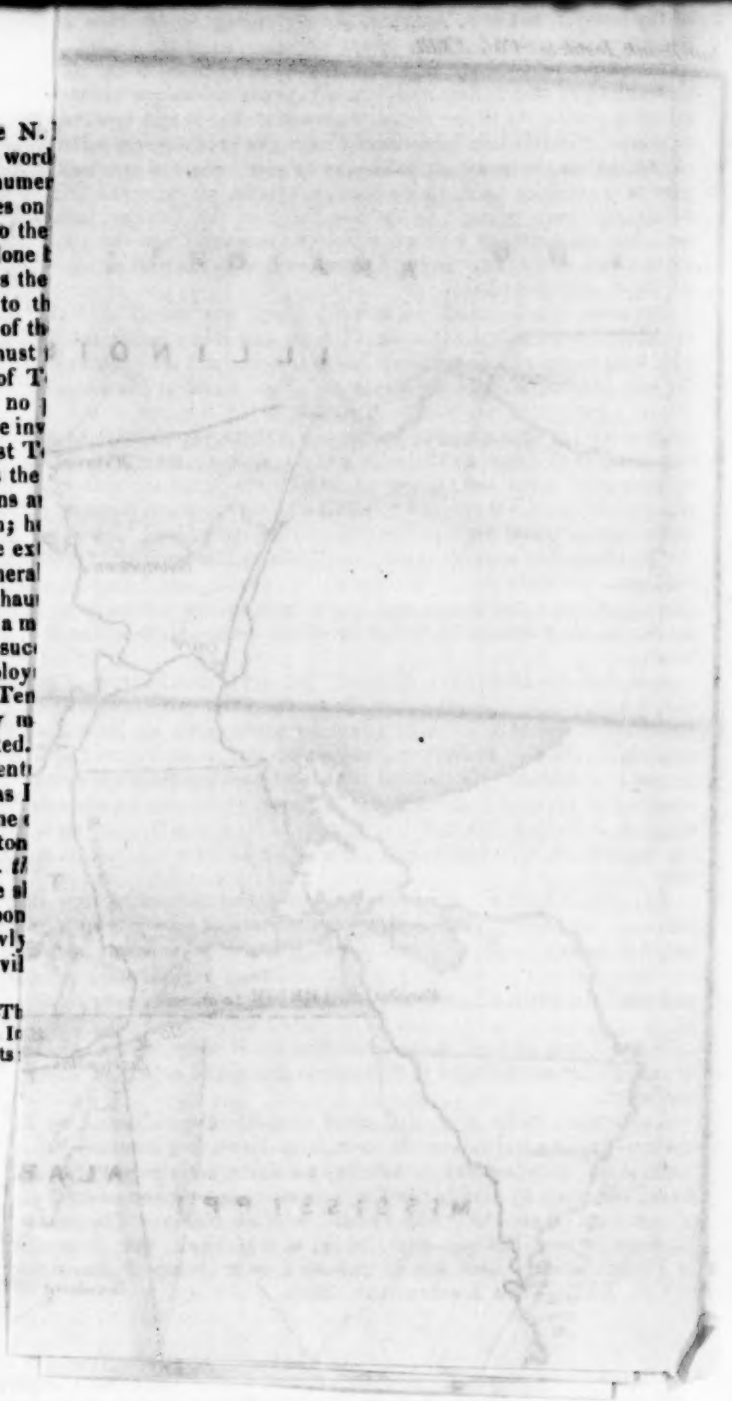

Tables, from a work about to be published, by E. H. Gill, Civil Engineer.

TABLE OF THE DISCHARGE OF WATER THROUGH IRON PIPES.

(Calculated from Eytelwein's Formula.)

Diameter of pipe in inches.	Head 5 feet; length 100 feet. Velocity of water in feet per second.	Head 5 feet; length 100 feet. Discharge in cubic feet per minute.	Head 10 ft; length 100 feet. Velocity of water in feet per second.	Head 10 ft; length 100 feet. Discharge in cubic feet per minute.	Head 20 ft; length 100 feet. Velocity of water in feet per second.	Head 20 ft; length 100 feet. Discharge in cubic feet per minute.
3	5.27	15.49	7.45	21.99	10.54	30.96
4	5.95	30.52	8.41	43.14	11.90	60.68
5	6.57	54.59	9.31	77.36	13.17	109.02
6	7.07	83.26	10.	117.78	14.14	166.26
7	7.50	118.89	10.61	168.18	14.99	237.42
8	7.92	167.50	11.20	236.88	15.84	334.50
9	8.25	218.64	11.67	309.27	16.51	436.80
10	8.51	276.23	12.11	393.09	17.13	556.02
11	8.87	353.74	12.55	500.51	17.75	707.16
12	9.12	429.76	12.90	607.89	18.25	859.56
13	9.36	514.42	13.24	727.66	18.72	1028.82
14	9.60	619.25	13.58	875.98	19.21	1239.
15	9.80	721.53	13.86	1020.45	19.61	1443.66
16	10.	833.52	14.13	1177.75	19.99	1665.96
17	10.18	967.26	14.40	1368.22	20.37	1934.70
18	10.35	1097.36	14.63	1551.15	20.70	2194.56
19	10.50	1235.17	14.85	1746.89	21.	2469.60
20	10.66	1400.97	15.08	1981.87	21.33	2802.72
21	10.80	1558.56	15.27	2203.64	21.60	3116.88
22	10.93	1724.88	15.45	2438.19	21.86	3449.46
23	11.06	1921.25	15.64	2716.85	22.13	3843.96
24	11.18	2107.38	15.81	2980.11	22.36	4213.92

	Head 10 feet; length 1000 feet.		Head 20 ft; length 1000 feet.		Head 50 ft; length 5000 feet	
3	2.48	7.29	3.51	10.31	2.49	7.32
4	2.85	14.53	4.03	20.55	2.88	14.68
5	3.20	26.49	4.53	37.51	3.23	26.74
6	3.49	42.78	4.93	56.20	3.53	40.12
7	3.75	58.50	5.30	82.68	3.79	59.12
8	4.02	84.42	5.69	107.49	4.07	85.47
9	4.25	112.20	6.01	158.66	4.31	113.78
10	4.47	144.82	6.31	204.44	4.53	146.77
11	4.69	185.72	6.63	262.54	4.77	188.89
12	4.88	228.41	6.90	322.92	4.91	229.78
13	5.05	276.27	7.15	390.39	5.17	282.28
14	5.26	337.89	7.43	477.	5.38	345.39
15	5.42	396.74	7.66	560.71	5.56	406.99
16	5.58	462.02	7.89	653.29	5.71	472.78
17	5.76	546.04	8.14	777.67	5.91	560.26
18	5.90	623.04	8.35	881.76	6.08	642.04
19	6.06	712.65	8.55	1005.48	6.23	732.64
20	6.20	814.68	8.77	1152.37	6.40	804.96
21	6.34	912.96	8.97	1291.68	6.55	943.20
22	6.49	1024.12	9.15	1443.87	6.70	1057.26
23	6.62	1167.90	9.36	1623.02	6.85	1187.79
24	6.74	1269.81	9.53	1795.45	7.	1380.80

from the N. E. to the S. W.; and of that from the S. E. to the N. W. in other words, it is the *great cross road of the union.*

The numerous mountain ranges which occupy the region extending to 200 miles on each side of it, forbid the construction of a rival road; and ensure to the Hiwassee rail-road two sources of income, either of which would alone be sufficient to warrant its construction.

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These she is now engaged in making; and in a very few years she will burst upon the notice of her sisters, with almost as strong claims to novelty as a newly discovered country.

JOHN C. TRAUTWINE.

Knoxville, Nov. 1838.

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MAP

illustrative of the

INTERNAL IMPROVEMENT SYSTEM

of the

SOUTH.

Prepared by

JOHN.C.TRAUTWINE

Civil Engineer.

Remarks.

This colour represents rail roads already chartered.

This colour represents those not yet chartered.

Those towns and rivers which are not essential to the particular object of the Map, are omitted.

PENNSYLVANIA

OHIO

INDIANA

ILLINOIS

KENTUCKY

VIRGINIA

TENNESSEE

N. CAROLINA

S. CAROLINA

GEORGIA

ALABAMA

MISSISSIPPI

Beaver

Pittsburg

Wheeling

Zanesville

Philadelphia

Chilicothe

Cincinnati

Baltimore

Winchester

Washington

Madison

N. Albany

M'Carmel

Frankfort

Louisville

Lexington

Fredericksburg

Evansville

Ohio R.

Shawneetown

Cairo

Charleston

Gr. Kanawha R.

James R.

Richmond

Lynchburg

Salem

Petersburg

Norfolk

Wythe C.H.

Abingdon

Blountville

Cumberland gap

Cumberland R.

Nashville

New R.

Blakely

Knoxville

Broad R.

Raleigh

Tennessee R.

Asheville

Fayetteville

Wilmington

Memphis

M. & L. R.R. 50 M.

La grange

110 M.

Tuscumbia

Muscle Shoals

Huntsville

T. & D. R.R. 43 M.

Decatur

New Echota

Athens

Georgia R.R. 171 M.

Columbia

Cincinnati R.R.

Tuscaloosa

Coosa R.

Selma & Tennessee RR. 110 M.

Selma

Montgomery

Weaumpka

C. & W. R.R.

M. & W. P. R.R.

F. Williams

F. Mitchell

West Point

Columbus

Talbotton

Forsythe

Macon

Central R.R. 200 M.

58 M.

65 M.

Augusta

S. Carolina R.R. 136 M.

Branchville

Charleston

Savannah

Mississippi River

Natchez

Alabama R.

Chattahoochee R.

Flint R.

Mobile

28 M.

Pensacola

N. Orleans

Appalachicola

Brunswick

30 M.

DISCHARGE OF WATER THROUGH OPEN CANALS.

Descent.	Bottom 8 feet wide, top 12 feet, and depth 2 feet. Velocity in feet per second.	Discharge in cubic feet per minute.	Bot. 10 ft wide, top 16 ft, depth 2 ft. Velocity in feet per second.	Discharge in cubic feet per minute.
1 foot in 5000 feet	1.51	1631.88	1.59	2489.76
2	2.17	2353.32	2.3	3588.
3	2.69	2907.36	2.84	4430.40
4	3.12	3375.	3.29	5141.76
5	3.50	3787.56	3.69	5768.88
6	3.85	4160.16	4.06	6335.16
7	4.16	4502.52	4.39	6856.20
8	4.46	4821.12	4.70	7341.36
9	4.74	5120.28	4.99	7796.88
10	5.00	5404.32	5.27	8227.44
	Bottom 6 feet wide, top 18 feet, and depth 4 feet.		Bot 10 ft wide, top 22 ft, depth 4 ft.	
1 foot in 5000 feet	2.01	5808.96	2.13	8198.40
2	2.89	8337.6	3.06	11761.92
3	3.57	10284.48	3.77	14496.
4	4.13	11920.32	4.37	16803.84
5	4.63	13343.04	4.90	18835.20
6	5.09	14667.84	5.38	20670.72
7	5.51	15868.80	5.82	22360.32
8	5.89	16983.36	6.23	23934.72
9	6.26	18034.56	6.61	25409.28
10	6.60	19028.16	6.98	26807.04

Sketch of the Tunnel now under construction upon the Chesapeake and Ohio Canal, at the Paw-paw bend of the Potomac River, by ELLWOOD MORRIS, Prin. Assis. Eng. January 1st, 1839.

This Tunnel was adopted to avoid a circuitous navigation of six and a half miles and some very expensive work at the pass of the Paw-paw Ridge.

Of this six and a half miles the U. S. Engineers in their celebrated report on the Chesapeake and Ohio Canal (Ex. doc. No. 10, 19th Congress 2d sess.) speak in these words: "In approaching the neighbourhood of Paw-paw Ridge, the difficulties gradually increase until they reach an extent that is truly formidable, and will require all the resources of art successfully to overcome them."

Although their distinguished engineers did not, in their report, recommend a Tunnel through the Paw-paw Bend, to avoid the difficult passage around it, yet Lt. Col. Abert (now Col. and Chief of the U. S. Top. Eng.) who directed the surveys upon the Potomac, marked upon his map of the pass of the Paw-paw Ridge, a Tunnel line which he recommended to be examined before finally deciding upon the plan of this division of the canal.

These considerations emanating from such high authority, induced a careful instrumental survey of the pass; which resulted in the development of a Tunnel route, immediately at the gorge of the bend, cutting off about two miles more distance than would have been done by the line indicated by Lt. Col. Abert.

This route as finally laid down (by C. B. Fisk, Esq., Chief Engineer of the

Canal) in June, 1836, gives a Tunnel of 3118 feet in length, and measures from river to river one and a half miles, while the distance around the bend (by a location made for the canal, previously to adopting the tunnel route) is six and a half miles; thus making a clear saving of five miles.

The length of the tunnel, as above stated, is 3118 feet, the highest summit of the ridge under which it passes, 362 feet above the bottom of the canal, (see fig. 1) and the material a hard blue slate rock.

It is (if I am correctly informed) the longest tunnel yet undertaken for any road or canal in North America; though many of greater magnitude have been constructed in Europe.

Its transverse section as cut, is twenty-seven feet extreme width, by twenty-five and a half feet extreme height. But when finished it will not (on account of the arch) present so great a section; (see fig. 2.)

The Tunnel is wrought in *two* sections or breasts; 1st, The *Heading*, the floor of which is level, twelve and a half feet below the top of the excavation. 2d, The *Bottoming*, which is a thorough cut, thirteen feet deep, (see figs. 1 and 3.)

The heading is driven in advance, and the bottoming excavated subsequently, leaving for the present a ledge on the towing path side, eight feet in width, on which a rail-road is laid down to carry out the excavated material. A similar rail-road is laid upon the canal bottom, which performs the same office for the rest of the work. Both roads are worked by cars and horses, and have upon the spoil bank an apparatus which unloads the cars by tilting, with very little trouble.

The Southern deep cut being comparatively light, was bottomed out in fourteen months; it was begun in August, 1836, and was so far excavated in June, 1837, as to enable the tunnel heading to be begun, which was accordingly commenced, and ten lineal feet were driven in that month.

Since that time (June 1837) the working from this portal has been prosecuted day and night without intermission (Sundays excepted.)

The northern deep cut being very heavy and requiring a long time to reduce it down to canal bottom, or even to the heading level, it was found necessary to sink shafts, in order to expedite the excavation of the tunnel: and for this purpose two double shafts (each eight feet in diameter and fifteen feet clear apart) were sunk: viz, shafts A and B, 122 feet deep; C and D, 188 feet deep, (see fig. 1.)

These shafts were sunk in pairs to facilitate the ventilation and give opportunity for employing a double hoisting apparatus to free them from water, and remove the materials excavated. Both of which are hoisted out by one-horse gins, one to each shaft; the horses being changed every eight, and sometimes in wet weather, every six hours.

The tunnel is now working at five points, viz: from the south portal, and *both* ways from *each* of the shafts, (see fig. 1.)

In driving north from the south portal, and south from shaft D, the work is carried on day and night (Sundays excepted) by three shifts of miners, each working eight hours out of twenty-four; and progresses, taking both workings together, at the rate of about seventy feet per month.

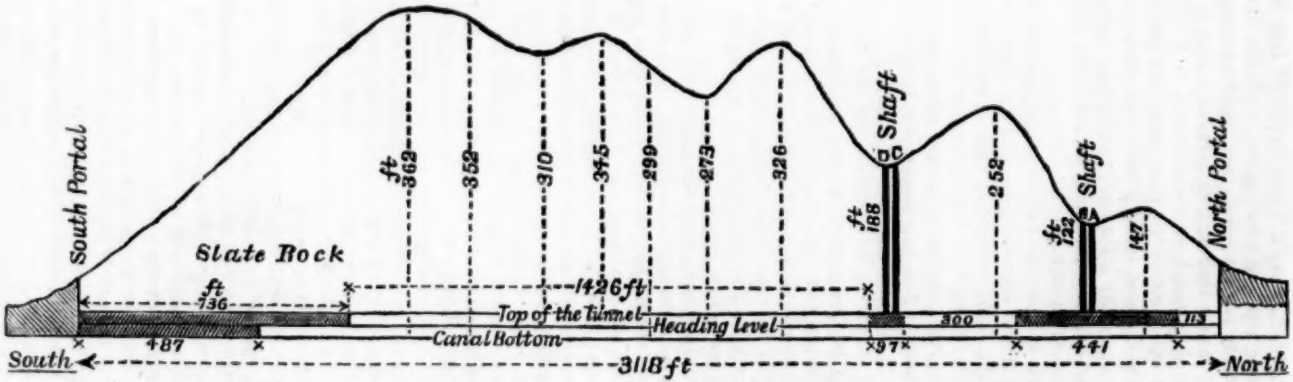
In the other shaft workings (a less distance being to drive from them) only two shifts of miners, or sixteen hours out of twenty-four, are at present wrought, making from each working about twenty-five feet monthly.

Owing to the large amount of rock excavation in the north deep cut, although it was begun in July, 1836, and has therefore been thirty months in hand, the tunnel will not be fairly opened at its northern portal before June

LONGITUDINAL SECTION OF THE TUNNEL, JANUARY 1st, 1839.

Magnetic Course of the Tunnel in 1836, *N* 6½° *E.*

Fig. 1



Scales. { Horizontal 500 ft. to the inch. / Vertical 200 do. do. } Heading driven = 1274 ft. lineal. / Do. to be done = 1844 do. } The shaded parts show what has been excavated: / The blank parts that which remains to be done.

Note.—The whole course of the Tunnel consists of slate rock (in inclined strata sometimes contorted) of a bluish gray colour, containing considerable lime and occasional veins of shell limestone.

1st, 1839, by which time the heading working north from the shaft A, (fig. 1) will be driven out to meet the open cut.

The two shafts, B and C, will also, by that time, be connected, and there will then remain about 1000 feet lineal of the heading to be driven between shaft D and the south portal.

The water of the canal through this tunnel will be seven feet in depth, the towing path for horses, six feet in width, and the headway of the tunnel clear of the water surface will be seventeen feet, (that being the height established on this canal for bridges, &c.)

The material through which this work is carried, is of a consistency, in general, quite equal to sustaining itself and carrying all the weight above it; yet in all probability from its slaty nature it would, if exposed and unprotected, yield in the course of time to the destructive action of atmospheric changes.

It is therefore contemplated to protect the interior by a lining of brick in the arch form, either one or two bricks in thickness. An arch of one brick (nine inches) thick, would doubtless answer the purpose, and will probably be employed.

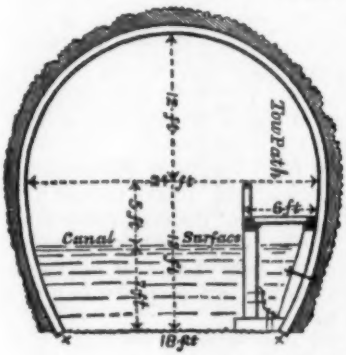
The present plan contemplates forming the tow path by a continuous wooden bridge open below, so as to allow the water to flow under and fill the whole water section of the tunnel, (see fig. 2.)

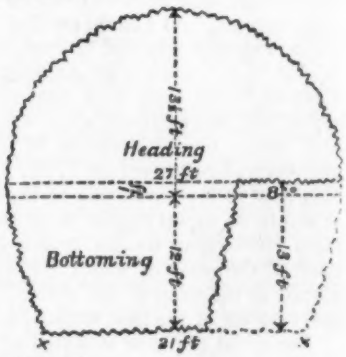
The workings so far have been as free from water as could reasonably be expected, the mean flow at present being at the foot of the shafts C and D near one and a half cubic feet per minute, at shafts A and B about one quarter of a cubic foot per minute, (all of which is hoisted out by the horse gins) and at the south portal about one cubic foot per minute, which drains off by the canal bottom. Thus making the entire flow of water about two and three quarter cubic feet per minute.

Owing to the arrangement of double shafts, the ventilation has always been good.

Fig. 2. Fig. 3.

Transverse Sections.





Scale 15 feet to the inch.

Physical Science.

Notice of Prof. STRUVE's *Micrometric Measures of double and multiple stars, with the great Dorpat Refractor, in the years from* 1824 *to* 1835. By SEARS C. WALKER.

On the occasion of the recent visit of Mr. Holcomb to Philadelphia to place in the Exhibition of the Franklin Institute, one of his seven feet Herschelian reflectors, I was informed by that meritorious artist that γ Virginis, from having been perfectly single with the highest powers in his fourteen feet reflectors from 1833 to 1836, has since undergone such a change as to be readily divided with a ten feet reflector. Mr. Holcomb also remarked that η Coronæ is now closer and more difficult to be divided than 36 Andromedæ. He has, on two occasions, separated η Coronæ; not, however, so completely as to make the discs tangent to each other. This was effected with a fourteen feet reflector under highly favourable atmospheric circumstances. 36 Andromedæ he has, with a ten feet reflector, recognised to be a double star. Both η Coronæ and 36 Andromedæ, were in 1830 pronounced, by Sir John F. W. Herschel, to be exceedingly close and difficult to divide (the former of them more so) even with his twenty feet reflector. That Mr. Holcomb, in the interior of New England, almost without assistance, should have carried the art of polishing specula to such a degree of perfection as to detect a variation in the distance of two pairs of stars so close as η Coronæ and γ Virginis, is somewhat surprising, and certainly without a parallel in this country. To test the correctness of Mr. Holcomb's remarks, I examined the British publications on this subject. The opening of γ Virginis is quite in conformity with Sir John F. W. Herschel's predictions previous to his departure for the Cape of Good Hope. Their nearest approach appears, by his elements of their orbit, to have taken place in 1835.5; their distance at that time should have been 0."79, and their present distance 1."6 which would confirm Mr. Holcomb's observations. As I could not find any recent English measurements of η Coronæ, recourse was had to Prof. Struve's measurements published in Schumacher's Astronomische Nachrichten. These show that the two stars of η Coronæ which were 1."0 distant in 1836, were only 0."7 in 1835.4, and were still approaching each other. Their distance at this time is 0".5, and again the observation of Mr. Holcomb is confirmed. As there are several reflectors of 7, 10, and 14 feet focal length by Holcomb and Son now in the possession of individuals and colleges, I have thought that it would be useful to give in an English dress some of the most remarkable facts concerning double revolving stars, contained in Struve's announcement of the work of which the title translated from Latin to English is placed at the head of this notice. Previous to this it is proposed to give a short notice of the best telescopes now in use.

The great reflector mounted at the Dorpat observatory in 1825, is a lasting monument of the genius of Joseph Fraunhofer. Its focal length is 13.3 feet, and its clear aperture 9.6 English inches, being one-third larger than that of any achromatic reflector that had hitherto been made. The testimony of its proprietor, as well as of every astronomer who has visited Dorpat, shows that this instrument surpasses all other equatorial refractors previously erected, as much in the mechanical skill displayed in its mounting,

as in its optical capacity. The early death of the great optician who constructed it cannot be too much lamented. The loss to science has fortunately not been irreparable. His surviving partner, J. Von Utschneider, whose wealth enabled Fraunhofer to prosecute his optical discoveries, still retains the art in its greatest perfection. Another instrument, the fellow of the Dorpat refractor, has, since the death of Fraunhofer, been completed by Utschneider for Prof. Encke, at the Berlin Observatory. With it that celebrated astronomer has recently proved the existence of a second division of the ring of Saturn, which had been stated before, but without sufficient confirmation, by Capt. Kater and others. An improvement in the mounting of Encke's Equatorial over even that of the Dorpat, has been introduced through the mechanical contrivance of Mr. Mahler. This enabled Encke, on the first re-appearance of the comet, which bears his name, in September last, to determine its place by simply bringing the comet to the centre of the field, and reading the graduation on the hour and declination circles. Two other refractors of 15 feet focal length, and 11.2 English inches aperture, have been made at the same establishment, the optical part of which is under the direction of Mr. George Merz.

With one of them lately mounted at the Bogenhausen Observatory in Munich, the Director, Mr. Lamont, has observed the sixth Satellite of Saturn and the third Satellite of Herschel, neither of which had been observed by any other astronomer living, the 20 feet reflector of Sir John Herschel having proved inadequate to the task. Another refractor of 23 feet focal length and 15.3 English inches aperture was ordered in 1834, by Struve, for the Central Observatory of Pulkova, near Petersburg, at an expense of 76,000 roubles, [$16,000.] This instrument was partly finished when Pres. A. D. Bache visited Munich in the spring of 1838. A letter just received from George Merz, by Mr. Geo. M. Justice, states, in excuse for the delay in completing the instruments ordered for the Philadelphia Observatory, that this great refractor, and a smaller one of 9.7 feet length and 7 inches aperture mounted as a heliometer, have just been completed after four year's labour. The Pulkova refractor, though inferior perhaps in optical capacity to Sir William Herschel's 40 feet reflector, will far surpass it in precision of measurements.

Two refractors of 19 feet focal length, and 11.8 inches aperture, in the possession of Sir James South, and of the Cambridge Observatory, are the workmanship of M. Cauchoix of Paris. An imperfection in the mounting of the former by Troughton and Simms, and a protracted law suit consequent thereon, has deprived the world of the valuable labours of Sir James South. The Cambridge refractor is not yet mounted. There is however a refractor by Cauchoix second only in power to the great Pulkova refractor, in the possession of Mr. Cooper of Ireland. This equatorial mounted at that gentleman's observatory is twenty-five English feet in length, and 13.3 inches aperture. Though superior in dimensions to the Bogenhausen refractor, there are few published observations with Cauchoix's refractors that indicate a superiority in optical capacity. On the contrary the two observations of Lamont already alluded to are almost without a rival in the nineteenth century. I should have stated that they are wholly without example, but for the recent observations said to have been made by P. De Vico, at the Roman College, Rome, with a telescope which its maker, Cauchoix, states, Astr. Nachr. 305, to be of the same size as that of the Transit instrument made by him for the Paris Observatory. P. De Vico is said by Dumouchel, Astr. Nachr. 357, to have seen six rings of Saturn on several evenings, and in the course of

the summer of 1838, all of the seven satellites of Saturn. As the seventh or innermost satellite has not been seen this century by the most powerful telescopes in use, this discovery, if authentic, while it affords the most remarkable testimony in favour of Cauchoix's telescopes, shows also that the serenity of the sky of Italy is such as to set aside the distinctions of optical capacity of telescopes that prevail in more northern climates.

It is worthy of remark, that the star or rather the stellar system η Coronæ, already mentioned, furnishes a singular test of the comparative excellence of telescopes. Mr. Holcomb speaks of the two stars of η Coronæ the principal and its companion. It is evident that the telescopes he has yet made are not adequate to the exhibition of a second companion or satellite. Sir John F. W. Herschel has, with his twenty feet reflector, seen this second companion, with a power of 300. As no mention is made of it in Struve's notice of his *mensuræ micrometricæ*, where repeated measures of distance and position of the first are given, it is clear that the Dorpat refractor is too small to exhibit this second companion. It has however been observed by Lamont, and its distance and position carefully measured—another instance of the wonderful power and precision of measurement afforded by the Bogenhausen refractor, as Sir John F. W. Herschel had only determined these quantities by conjecture. Mr. Lamont has also determined the distance and position of the small companion of α Cancri of the twentieth magnitude. Sir John F. W. Herschel remarks that this small star is nearly equal in lustre to the largest of the satellites of Herschel, and that no telescope is adequate to show the latter which does not also exhibit the former.

To return to the subject of Struve's micrometric measurements—these contain the result of the arduous labours of that indefatigable astronomer since 1824. Some idea of their magnitude may be formed when we are told that they amount to 10,500 observations, counting for a single one the entire set of observations of a double star made in a single day even when often repeated. These have been portioned out among 2707 pairs of stars, of which none have been observed less than twice. In making them, Struve used a spider line micrometer visible in an illuminated field. For very faint stars he used an invention peculiar to Fraunhofer, by which the lines are made luminous in a dark field, without concealing the faintest objects from view. It does not appear that any British artists have succeeded in imitating this illuminated line micrometer. Hence many observations of comets, nebulæ and faint double stars have been omitted, or their place supplied by conjecture, which this invention would have furnished. I am informed by Pres. A. D. Bache that an inconvenience occurs in the present mode of arranging these micrometers, viz: that the spider lines are only illuminated on one side, requiring a correction to be applied for the observed transit over the line.

Many of Struve's measurements of the brighter double stars were made in the day time. The powers used were from 320 to 1000. The value of a turn of the micrometer screw, was 15.″315. The screw was sub-divided into 100 parts, thus reading to 0.″153; or (since the tenth part of a division could be easily distinguished) to 0.″0153. The position circle had two verniers each reading to a single minute.

In 1827 Prof. Struve published his *Catalogus novus*, or new Catalogue of double and multiple stars. In 1836 he announced his *Mensuræ Micrometricæ*, a work of which the title is placed at the head of this notice. It is published by the Imperial Russian Academy, and contains a complete re-

view of the double stars visible at Dorpat to the number of 2622, whose distance asunder is less than 16″. The angles of position reckoned from the north in the declination circle eastward round the circle, are given for different dates, and their distances, magnitudes, right ascensions and declinations are also stated. These singular pairs and multiples of stars thus given for a particular epoch in position, bearing, apparent distance and magnitude, with an accuracy hitherto unattained by any other astronomer, will remain for ages the subject of observation, and comparison.

It has not been the object of Prof. Struve to compute the orbits of double stars; but to furnish a general review of the heavens so that others may be guided in their selection of the proper objects of research.

The number of stars known to revolve round each other was stated by Sir John F. W. Herschel 1831 to amount to about 40, of which the elliptical elements of nine pairs, computed chiefly by himself, are given in his astronomy. His observations at the Cape have added to the number, and there can be no doubt that the *Mensuræ Micrometricæ* of Struve will serve to increase it. The attention of astronomers is particularly called to twenty-eight of the most remarkable pairs, and triplets of these stars in his paper, published in the Astronomical Notices No. 304; of these it is proposed to furnish a list, with occasional references to the more recent results obtained by Dr. Mädler, of the Berlin Observatory.

423 Atlas Pleiadum R. A.; 3h. 38.9m., Dec. + 23° 30′.

These difficult double stars were measured once in 1827. They were seen elongated in 1830. Since then there has been no trace of the companion.

*1356 α Leonis H. 1.26. R. A., 9h. 19.0m., Dec. + 9° 50′ mag. 6.2 and 7.0.

Epoch.	Distance.	Direction.	Days of Observation.
1782.87		110°.90	
1804.09		130 .88	
1825.21	0″.970	153 .94	5
1832.25	0 .515	163 .40	2
1833.29	0 .447	172 .80	3
1835.33	0 .3	177 .40	3

From these it appears that the motion is direct. Probably these stars passed their aphelion between 1804 and 1825. In 1804, they were four times as distant as in 1782, and twice as distant as in 1795. In 1836 and 1837 the two stars should have ceased to appear double in any telescope. Shortly afterwards the companion was expected to emerge on the other side.

* On examining this very close pair of stars, with the 7 feet Herschelian by Holcomb on the 8th of January, 1839, an evening remarkable for its serenity, I was induced to believe that the companion has already emerged, as was anticipated.

1670 γ Virginis, H. 3.18, R. A., 12h. 32.8m. Dec. — 0°.29, both of 3d mag.

1825.32	2″.373	277°.92	6	Struve.
1828.38	2 .070	271 .50	1	"
1829.39	1 .782	268 .28	5	"
1831.36	1 .492	260 .92	5	"
1832.52	1 .262	253 .50	4	"
1833.37	1 .056	245 .53	7	"
1834.38	0 .912	231 .66	5	"
1834.84		214 .60	1	"
1835.38	0 .514	195 .48	9	"
1836.41	0 .257	151 .57		"
1837.20		100 .42		Encke.
1837.41	0 .595	78 .12		Struve.
1837.48	0 .626	76 .40		Encke, Galle, Mädler.
1838.41	0 .867	52 .03		Struve.
1838.42	0 .768	50 .65		Otto, Struve.
1838.43	0 .830	49 .20		Galle, Mädler.

These two stars are variable in brightness, sometimes one, sometimes the other, appearing the brighter. The direction of these stars was noted by Bradley in 1718, and by Mayer in 1756. During this century they have revolved through more than half their orbit, and have diminished their distance from 6″.5 to 0″.3, and are again receding. Herschell II's period of revolution, 660 years, appears no longer tenable. Mädler, in the Astr. Nachr. 363, finds the period to be nearly 160 years.

1728 42 Comæ Berenices R. A., 13h. 1.6m., Dec. + 18° 28′, both 6th mag. One is however smaller than the other and is somewhat yellow.

1829.40	0″.640	11°.6
1833.37	single	
1834.45	elongated	228 .3
1835.39	0 .3	191 .2

From which it appears that one has retrograded upon the other, through 180°.4 of its apparent orbit, in 5.99 years. Between 1829 and 1835 a central occultation of the two stars has taken place. They were readily divisible in 1827, 28, 29, with a power of 600. In 1833 they remained single and perfectly round with a power of 1000.

1937 ϱ Coronæ H. 1.16. R. A. 15h. 16.1m., Dec. + 30° 36′.

1826.77	1″.075	35°.28	4 days.
1829.55	0 .960	43 .25	2
1831.63	0 .883	50 .63	3
1832.76	0 .790	56 .87	3
1835.42	0 .732	74 .75	7
1836.52	0 .563	88 .77	

Period of their orbit 46 years, in 1835, still approaching each other. In 1838.5, distance 0.″507, according to Mädler's Ephemeris Astr. Nachr. No. 354.

1967 γ Coronæ, R. A. 15h. 35.5m. Dec. + 26° 52′.

These two stars of the 4th and 7th magnitude, present an example of a complete central occultation.

1826.75	0″.725	111°.05	2 days.
1828.98	0 .540	110 .7	3
1832.21	0 .4	102 .7	3
1833.34	0 .4	105 .8	2
1835.44			

Three trials on different days with a power of 1000, under favourable circumstances, showed them single without the slightest variation from the circular form.

2055 λ Ophiuchi H. 1.83. R. A. 16h. 22,1m., Dec. + 2° 22′. 4.0 and 6.1. mag.

The measures of the elder Herschel and of Struve give

1783.18		75.°4	
1802.39		69. 32	
1825.51	0.″837	331. 80	3 days.
1828.51	0. 813	342. 10	3 "
1831.90	1. 043	349. 47	3 "
1834.42	0. 987	350. 60	2 "
1835.55	0. 996	352. 48	5 "

As the first observations do not conform with each other, if we change the direction of the first by adding 180° it will appear probable that these two stars revolve round each other in a period of less than 40 years.

2084 ζ Herculis — H. I. 36. R. A. 16h 34.8′, Dec. + 31° 55′, 3.0 and 6.5 mag.

This wonderful pair of stars has, in a period of not more than 6 years, exhibited the phenomenon of the disappearance of the companion and its re-appearance on the other side of the principal star.

The measures of the elder Herschel and of Struve are,

1782.55	D	69.°3		
1795.	smaller than D	between 0° and 90°		
1802.	the star is single.			
1826.63	0.″910	23.°40	5 days.	
1828. 1829. 1831.	The star is single under the most favourable circumstances, with the greatest magnifying powers.			
1832.75	0.″81	220.°5	1 day.	Struve.
1834.45	0. 910	203. 5	2 "	"
1835.55	1. 094	197. 1	5 "	"
1836,58		188. 02		Mädler.
1836.60	1. 090	186. 30		Struve.
1838.70	1. 350	168. 50		Galle.

The only hypothesis that will reconcile all these observations is that of an orbit of about 14 years duration. Whether this is correct or not must be decided by future observations. Such was the opinion of Struve in 1836. Dr. Mädler, in Astr. Nachr. 363, finds a period of 36.3375 years as the result of the more recent observations.

2262. τ Ophiuchi = H. I. 88. R. A. 17h 53.4m. Dec.—8° 10′

This pair which, in 1783, Herschel pronounces to be the closest of all the double stars, exhibited, ten years ago, the opposite phenomenon of that which γ Coronæ, and α Leonis have presented. In 1825 Struve could see no trace of the companion. In 1827 the star appeared elongated. In 1835 on six different days they appeared as two small stars of 5.th and 5.5 magnitude in contact with each other. Their centres were 0.″35 asunder, the mean angle 256.°7:

3062 = H. I. 39. R. A. 23h 57.1m, Dec. + 57° 28′. Mag. 6·9 and 8.0.

The elder Herschel's and Struve's observations give;

1782.65		320.°7	
1823.81	1.″25	36. 7	
1831.71	0. 820	87. 5	2 days.
1833.71	0. 557	108. 57	3 "
1835.66	0. 420	132. 62	5 "
1836.61	0. 466	146. 38	

The motion of the companion is direct and amounts to 65° in the last 3.95 years. The period cannot yet be determined. Future observations will be necessary to show whether the companion, between 1783 and 1823, revolved through 76° or 436° of its orbit. This was Struve's opinion in 1835. Dr. Mädler, Astr. Nachr. 344, finds a period of 84.5140 years.

1196. ζ Cancri = H. I. 24 et 111. 19. R. A. 8h 2.1m, Dec. + 18° 10′
A. 5.0, B. 5.7, C. 5.5 mag.

A. and B.				A. and C.			
1826.22	1.″140	57.°63	3 days.	1826.22	5.″300	154.°67	3 days.
1828.80	1. 040	38. 45	2 "	1828.99	5. 313	151. 38	3 "
1831.28	1. 048	29. 80	6 "	1831.28	5. 402	148. 57	6 "
1832.28	1. 150	27. 52	4 "	1832.28	5. 520	148. 60	4 "
1833.27	1. 147	22. 10	3 "	1833.27	5. 470	147. 60	3 "
1835.31	1. 136	20. 12	5 "	1835.31	5. 318	145. 44	5 "

1523. ξ Ursæ majoris. = H. 1.2 R. A. 11h 8.8m, Dec. 32° 30.

1826.20	1.″748	238.°75	3 days.
1827.27	1. 715	228. 27	4 "
1829.35	1. 671	213. 59	7 "
1831.44	1. 706	203. 82	5 "
1832.41	1. 750	195. 94	5 "
1833.38	1. 695	188. 24	5 "
1834.44	1. 875	184. 10	2 "
1835.42	1. 764	180. 18	5 "

1938. P. XV 74 prope μ Bootis = H. 1.17. R. A. 15h 18.0m, Dec. + 37° 56′.

1826.77	1.″385	327.°00	2 days.
1829.73	1. 243	324. 05	2 "
1833.85	1. 190	319. 17	3 "
1835.55	1. 103	318. 63	3 "

The stars are still approaching each other.

1998. ξ Libræ = H. 1. 33. et II. 20. R. A. 15h 54.7m Dec. — 10° 53′.

The observations of the elder Herschel and Struve, give

	A. and B.			$\frac{A. + B.}{2}$ and C.			
1782.36		187.°94		1782.36		88.°62	
1825.47	1.″147	355. 97	3 days	1825.48	6.″750	78. 60	4 days.
1832.00	1. 225	4. 15	2 "	1832.00	6. 670	76. 75	2 "
1833.91	1. 240	5. 85	2 "	1833.91	6. 965	75. 20	2 "
1835.00	1. 235	7. 30	2 "	1835.00	7. 020	75. 40	2 "

2032. σ Coronæ = H. 1.3. R. A. 16h 7.9m, Dec. + 34° 20′.

1827.02	1.″312	89.°35	4 days.
1830.11	1. 220	104. 90	3 "
1832.99	1. 297	118. 80	3 "
1835.50	1. 308	130. 46	5 "

1757. P. XIII. 127. R. A. 13h 25.4m, Dec. + 0° 35′. 7.8 and 8.9 mag.

1831.78	1.″544	20.°97	7 days.

The angle in 1825 was 10°, and in 1835, 25.°6. Hence a change of the angle is rendered certain.

1424. τ Leonis = H. 1. 28. R. A. 10h 10.4m, Dec. + 20° 44′.

1828.14	2.″458	102.°03	6 days.
1831.34	2. 484	103. 26	5 "
1832.75	2. 504	103. 46	5 "
1835.16	2. 562	104. 94	5 "

1536. ι Leonis. R. A. 11h 14.8m, Dec. + 11° 29′, 3.9 and 7.1st mag.

1832.01	2.″193	92.°38	12 days.

The angle is regularly diminishing, so that for the epoch t it may be denoted by

$$92°38 - 0.°834\ (t - 1832.01)$$

1909. 44 Bootis = H. 1.15. R. A. 14h 58.0m, Dec. + 48° 22′, 5.2 and 6.1 mag.

The observations of this pair shew a remarkable increase in distance between 1826 and 1835, while the angle has undergone but little change. The comparison of the early observations with the more recent, leads to a very interesting result.

1781.62	less than 2.″	60.°1	
1802.25		62. 9	
1819.43	1.″5	228. 0	
1821.33		229. 1	
1826.79	2. 230	231. 0	1 day.
1829.20	2. 555	233. 65	2 "
1832.95	2. 963	234. 47	3 "
1835.51	3. 173	235. 23	6 "

These data indicate that the plane of the orbit of the companion passes nearly through the solar system. As the distance has been continually increasing since 1819, and as the elder Herschel saw the companion on the other side of the principal, it appears that a central occultation must have taken place between 1802 and 1819. Probably the companion was between 1781 and 1802 at its greatest elongation on the one side. It is now approaching its greatest elongation on the other side.

2909. ζ Aquarii = H. 11. 7. R. A. 22h 19.8m, Dec. — 0° 55′

1825.73	3.″600	359.°80	2 days.
1832.81	3. 458	355. 29	3 "
1835.66	3. 356	353. 20	5 "

The well known increase of the angle of position of these stars, appears now to be accompanied with a variation of their distance.

2120. Herculis 210. R. A. 16h 57.6m, Dec. + 28° 20′, 6.4 and 9.2 mag.

The mean of 11 measures from 1829 to 1835 gives

1833.25	3.″445	3.°08

The distance and angle are rapidly diminishing.

1110. Castor = H. 11.1. α = 7h 23.5m Dec. + 32° 15′.

1826-22	4.″404	262.°54	5 days.
1827.28	4. 417	262. 32	4 "
1828.89	4. 358	261. 10	5 "
1831.31	4. 464	259. 58	5 "
1832.86	4. 525	257. 72	4 "
1835.33	4. 734	255. 48	5 "
*1836.26	4. 647	255. 62	

It is remarkable that Struve's measures shew the distance to be increasing, while *Herschel II*, from his researches concerning the orbit of Castor, has arrived at the opposite conclusion, viz: that these two stars should still approach each other, till in 1856 they are to be only 0.″68 apart. The observation of Dr. Mädler confirms the remark of Struve. The angular motion of the companion is so slow, and the change of distance so small, that perhaps half a century of nice observations will be required to determine the elements of its orbit.

1263. Anonyma. R. A. 8h 33.7m, Dec. + 42° 19′, 7.6 and 8.2 mag.

This pair of stars offer a remarkable change of distance and angle, as appears from the following mean yearly results.

1828.36	4.″86	359.°0	1 day.
1829.36	5. 43	4. 12	2 "
1831.31	7. 08	4. 95	2 "
1832.33	7. 455	7. 27	2 "
1833.29	7. 973	8. 00	3 "
1834.36	8. 953	8. 40	3 "
1835.35	9. 595	9. 29	4 "

1888 ξ Bootis = H. 11. 18. R. A. 14h 43.3m, Dec. + 19° 49′.

1829.46	7.″217	334.°17	4 days.
1832.40	7. 140	331. 10	2 "
1835.43	7. 070	328. 98	5 "

* Mädler's observation.

2272 70 *p* Ophiuchi = H. 11.4. R. A. 17h 56.6m, Dec. + 2° 33′.

Struve's measures give:

1819.64		168.°48	5 days.
1820.77		160. 25	2 "
1821.74		157. 65	5 "
1822.64		153. 87	3 "
1825.57	3.″984	148. 22	14 "
1827.02	4. 275	145. 15	2 "
1828.71	4. 782	140. 22	4 "
1829.59	5. 087	138. 08	6 "
1830.84	5. 310	135. 75	2 "
1831.68	5. 410	134. 70	5 "
1832.75	5. 553	133. 97	3 "
1834.47	5. 852	131. 15	4 "
1835.60	6. 108	130. 76	5 "

60. *a* Cassiopœia = H. 111. 3. R. A. 0h 38.5m, Dec. + 56° 53′.

1827.21	10.″25	85.°6	1 day.
1832.05	9. 780	87. 60	5 "
1835.26	9. 520	91. 23	3 "

These observations shew a diminution of the distance as well as an increase in the angle of position.

1516. Anonyma. R. A. 11h 3.7m, Dec. + 74° 25′, 7.0 and 7.5 mag.

This pair of stars is worthy of special observation.—Struve's measures give:

1831.54	9.″930	298.°70	2 days.
1832.84	9. 560	299. 37	2 "
1833.46	9. 250	299. 75	2 "
1834.43	8. 945	300. 97	2 "
1835.56	8. 425	301. 67	4 "

These show a diminution of distance and an increase in the angle of position. Besides South's and Struve's measures, an observation in the Histoire Celeste of Lalande, of the difference of R. A. and Dec., confirms this remark. The old observations give:

1790.21	29.″26 $\overline{+}$ 6″	298.°58 $\overline{+}$ 15°
1823.92	14. 22	
1824.28	12. 479	296. 27

From these measures there follows the remarkable result, that these two stars, now distant only 8″, were forty-five years ago 30″ asunder.

2708. Anonyma. R. A. 20h 32.0m, Dec. + 38° 1′, 7.0 and 8.7 mag.

Struve's observations give, from 1828 to 1835,

1832.63	11.″252	351.°72

The distance and angle are both varying, they may be thus expressed:

$$11.''252 + 0.''206\ (t - 1832.63)$$
$$351.°72 - 0.\ 823\ (t - 1832.63)$$

2758. 61 Cygni = H. IV. 18. R. A. 20h 59.0m, Dec. + 37° 54′.

These stars shew an increase in distance and angle of position.

1821.62	15.″02	84.°38	
1828.72	15. 31	89. 4	1 day.
1831.70	15. 632	91. 16	4 "
1832.77	15. 790	92. 35	1 "
1835.65	15. 967	93. 83	6 "

Examination of Col. Reid's work on the Law of Storms; by JAMES P. ESPY.

My friend, President A. D. Bache, on his return from Europe, put into my hands a highly interesting work by Lt. Col. W. Reid, C. B., of the Royal Engineers, being "An attempt to develope the law of storms, by means of facts, arranged according to place and time, and hence to point out a cause for the variable winds, with a view to practical use in navigation."

This work is illustrated by charts showing the direction in which the various storms investigated moved along the surface of the sea, and showing the locality of the ships whose logs are given in the body of the work.

This work furnishes many additional proofs of that beautiful generalization first hinted at by Franklin, afterwards by Dr. Mitchell, of New York, and lately established in the most satisfactory manner, according to the true principle of inductive philosophy, by Wm. Redfield, of New York: namely, "*Great storms which originate in the windward Islands of the West Indies; progress from the place of commencement in a curve towards the N. W., till on reaching the lat. of 30° N., when they are moving nearly towards the N., their motion after this is towards the N. E. as far as traced.*"*

From all the facts collected by Mr. Redfield, by the joint Committee of the American Philosophical Society and the Franklin Institute, and by Col. Reid, it would seem that these storms constantly become wider and wider, from their place of commencement, and perhaps elongated in their N. E. and S. W. diameter after they reach a lat. as high as 40° or 45°.

Col. Reid agrees with Col. Capper and Mr. Redfield, that these storms are in the form of great whirlwinds; and Sir John Herschel who is of the same opinion, "does not see how Mr. Espy's theory, though he considers it ingenious, is tenable against the indications of the barometer, for unquestionably if a large body of air, he says, were to set on every side inwards towards a central ascending column, the necessary effect would be an increase of weight of the entire barometric column."

Now this objection is so obvious, that any theory, which has no answer for it, or which does not contain an answer to it in itself, does not deserve the name of ingenious; and it arises from so imperfect or inaccurate a view of the doctrine which I teach, that I am sure as soon as Sir John shall see my papers on the subject, he will see and confess that the objection has already been fully answered. If I am right in this matter, Sir John owes it not merely to me, but to the cause of science, on a point which he acknowledges to be of immense importance, to come out and correct his mistake; for such is the weight of his name, that many will not think it worth while to examine a system which has been condemned by Sir John Herschel.

As to Col. Reid, his whole book is a proof that he is much fonder of truth than of theory. He will therefore do me justice. I was highly delighted

* Perhaps they sometimes turn E. or even S. E.

when this book came into my hands; for I saw immediately that it contained a great many facts and simultaneous observations, which would enable me at once to put my theory to a very severe test.

On reading the logs of the several ships, I kept the map of the particular storm open before me, and, drew my pencil across the point where the ship was, drawing an arrow so as to exhibit to the eye which way the wind was blowing at that time in that locality.

When several logs were read, and arrows made in every locality—I was not a little pleased to see, in all the storms, decided proofs of an inward motion of the air, if not exactly to one common centre, quite as nearly so as any one had a right to expect; because oblique forces are known to exist, which must vary the direction of the wind. I shall now give a few examples of that period of the several storms, in which I find the most simultaneous observations.

Savannah la Mar Hurricane of 3d Oct., 1780.

About 1 P. M., at Savanna la Mar, on the 3d, the gale began from the S. E. and continued with increasing violence until four in the afternoon, when it veered to the S., and became a perfect tempest, which lasted in force till about eight; it then abated. The sea during the last period exhibited a most awful scene; the waves swelled to an amazing height, rushed with an impetuosity not to be described on the land, and in a few minutes determined the fate of all the houses in the bay.

Log of the Badger, at Lucia Bay, Jamaica.

P. M., of 2d, moderate wind, N. E., at 9 hard rain, and continued raining all night with squally weather; at 10 A. M., of the 3d, tripped our anchor, let her drive within the point of the Fort till it bore N. by E., distant three quarters of a mile, and the eastermost N. E. by N., distance one mile and a half; heavy squalls with hard rain; down top-gallant sails.—1 P. M., wind N. E. let go the sheet anchor in five and a half fathoms; muddy; veered the cable, and brought both anchors ahead; continued very heavy gales with hard rain. At 4, let go another anchor. At 3.30 both sheet and bower anchors came home; veered away the clink round the mast, when the best cable parted and then immediately the sheet cable parted likewise. At 5, she was driving on shore very fast, when a gust of wind laid her down, with the comings of the hatchway in the water. By consent of the captain and officers, cut away the weather halyard to the main shrowds, when the main mast went about twenty feet above deck; she immediately righted, and drove broad-side on shore, abreast of the town; the sea making a free passage over us, when our boat went to pieces along side. At 5.30 cut the bower cable to let her swing end on. About 6 it fell calm for half an hour, when the wind shifted round to S. W., blowing a hurricane with strong flashes of lightning. At 10, it became quite moderate.

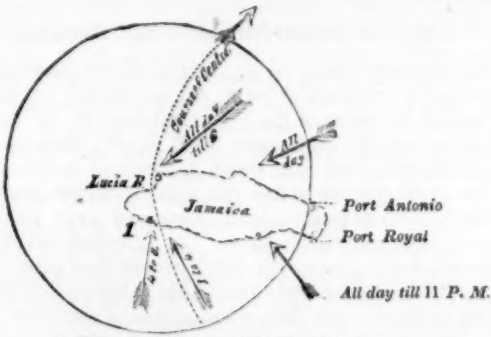
The Phœnix, off Port Antonio.

When the Phœnix was in company with the Barbadoes, off Port Antonio, the wind began to blow, with a stormy appearance, to the eastward, about 11 at night of the 2d of October, and the Phœnix then close reefed her top-sails. At 8 on the morning of the 3d, the wind was E. N. E. with occasional heavy squalls; and Sir Hyde Parker, who commanded the Phœnix, remarked that the weather had the same appearance as he had observed in

the commencement of a hurricane in the East Indies. He then ordered the top-sails to be taken in, and wore the ship in order to keep mid channel between Jamaica and Cuba. At 2 P. M., the Phœnix lay-to, with a storm mizen stay-sail, and her head to the northward. When night set in, the storm increased with great violence. At midnight the wind was southeast, and the ship drawing upon Cuba, Sir Hyde Parker determined to wear her, but no canvass could withstand the wind at this time, and she was wore by sending 200 of the crew into the fore-rigging. When about to cut away the masts, the ship took the ground on the coast of Cuba; and it was 5 o'clock in the morning of the 4th of October.

Journal of Princess Royal, in Port Royal Harbour.

On 2d October, the wind was S. E. and E. S. E., A. M, and the people employed in caulking the ship's bottom. P. M. the wind S. E. by E., and squally weather, with rain; people employed as before; violent squalls with heavy rain in the night, wind from the southeastward. On the 3d, A. M., the wind E. S. E. to S. E. and gale increasing with much rain; people employed in securing the ship; by the violence of the wind in the night the mizen-topsail, fore-top-gallantsail, and main-top-gallantsail, that were covering tents in the yard, and had been condemned by survey on the 30th of September, were entirely blown to pieces. P. M. wind S. S. E., and excessive hard squalls with thunder, lightning and rain; people employed as before. At midnight more moderate and light rain.



1. *Savannah la Mar; destroyed Oct.* 3, 1780.

These are all the data we have concerning this storm, yet it will be seen though we have no observations on the western half of this storm that the centre of it passed over Lucia bay, from 6 to 6½ P. M., and at that very time and for some time before and after, the wind on the other side of the island at Savannah la Mar, was blowing a hurricane from the south, exactly towards Lucia bay. The wind also at Port Royal in the southeast corner of the island was blowing nearly to the same point, and from the log of the Phœnix some place between the east end of Jamaica and Cuba the wind was violent E. N. E., almost exactly towards Lucia bay. The reader will observe that when the wind changed at Lucia bay, and with the Phœnix, all the four arrows, if drawn on the chart, would point to a spot near where the Phœnix was wrecked, not many hours afterwards, on Cuba.

Great Barbadoes Hurricane, of October 11, 1780.

At Carlisle bay, on the west side of Barbadoes, it was remarkably calm on

the evening of the 9th October, but the sky was remarkably red and fiery. During the night much rain fell. On the morning of the 10th, much rain and wind from the N. W. By 10, it increased very much. By 4, P. M., the Albermarle frigate parted and went to sea, as did all the other vessels, about twenty-five in number. By 10 P. M., the wind forced itself a passage through the house from the N. N. W., and the tempest increased every minute.

At St. Lucia,

All the Barracks and other buildings in the island were blown down.

At St. Vincent,

Every building was blown down.

At the town of St. Pierre, in Martinique,

Every house was blown down, and more than 1000 people perished.

At Fort Royal,

1400 houses, besides the churches and public buildings, were blown down.

At St. Eustatia,

On the morning of 10th, at 11 o'clock, the sky on a sudden blackened all round; it looked as dismal as night, attended with the most violent rains, thunder, and lightning ever known before. In the afternoon the gale increased. In the night every house to the northward and southward, was blown down or washed away into the sea, a few only escaping. The houses on the east and west were not so much hurt, till the P. M. of the 11th, when the wind, on a sudden, shifted to the eastward; and at night it blew with redoubled fury, and swept away every house.

At Barbadoes,

It began to blow on the 9th, but on the evening of the 10th the wind rose to such a degree of violence, as clearly to amount to what is called a hurricane. At 8 P. M. it began to make impression on all the houses by tearing off the roofs, and overthrowing some of the walls. It was thought to be at its greatest height about midnight, and did not abate considerably until 8 next morning.

Log of the ship Albermarle, lying in Carlisle Bay, on the west side of Barbadoes.

On the afternoon of the 9th, wind E. moderate and hazy. Morning of 10th, E. N. E., blowing very hard. At 1 P. M., N. E. by N. strong gales with hard rain at times. The gale increasing, the officers decided to go to sea, which was done at 2 P. M., wind N. N. E. At 30 minutes past midnight, still blowing a hurricane, with rain, and wind shifting to westward. At 5 in the morning, of 11th, the wind shifted round to the southward, still blowing very hard, with constant rain. At noon, still blowing a hurricane, with hard rain. P. M. still blowing a hurricane, with wind S. E. by S., with constant heavy rain. At 4 saw the northwest end of Barbadoes bearing N. E. by N. distance 4 or 5 miles. At 4.30, wind shifted round to S.E. and heavy gales of wind with constant rain. At 5 A. M., of 12th, more moderate but fresh gales continued S. E. in P. M.

Log of the Vengeance.

Moored in Careenage on west side of St. Lucia. Dark cloudy weather

on the afternoon of the 9th. The Blanche and Alcmene sailed at 6 A. M. of 10th. On the afternoon of 10th, strong squalls; at 7.30 P. M., very strong squalls, variable. At 9 P. M. the Ajax parted her cables and went out to sea. At 11 the gale increased very much. At 12 the Egmont slipped and went out to sea—wind variable all this time. At 4.30, A. M., of 11th, the Montagu slipped and ran out to sea. At 8.30, wind N. E., and the Amazon slipped and ran out to sea. Several transports drove on shore and dismasted in the harbour. At noon violent squalls and N. E. At 12.15, parted the small bower and brought up with the stream and sheet anchors. . . . . Cut away the long boat, cutter, and schooner tender, which were immediately dashed to pieces; the hurricane still increasing and the ship striking at times. At 8, wind N. E. by E., and veering round to eastward. At 9, lightning between the squalls, still blowing excessively hard, with rain. At 10, less wind with more rain and lightning. At 12, the hurricane abated with rain. At 4 on morning of 12th strong gales and squally, with heavy rain. At 11 A. M. wind E. S. E. In the afternoon, wind E. S. E., moderate, with rain. At 8, thunder and lightning and rain.

Log of the Alcmene.

At 1 P. M., of 10th, wind N. N. E.; fresh breeze and squally. At 2 P. M. got under way from the Careenage in St. Lucia, in company with the Blanche. At 5 P. M., N.$\frac{1}{2}$E., Martinique E.$\frac{1}{2}$N., 6 leagues. At 8, N. by E. At 10 N. N. E. At 3 in the morning of 11th, N. by E., hard gales and rain. At 7 N. N. E. At 10, very hard gales and rain; great sea. At 1 P. M., hard gales and thick weather with rain, wind variable. At 4, lost sight of the Blanche bearing S. S. E. half a mile. From 5 till 9, wind N. W. and gale increasing. At 12, gale still increasing, and wind S. E., from 10. At 3 A. M., of 12th, wind S. W. At 7, wind S. by W. At 10, gale abated, saw a ship ahead, supposed to be the Blanche. At 1 P. M., wind S. S. E., fresh gales and squally. At 3 P. M., wind S. E. At 10, saw Martinique E. by N., 5 leagues.

Log of the Egmont.

At 10 A. M. of the 10th, squally and wind variable. At 12, northwardly squally and hard rain, sailed from the Careenage in St. Lucia in company with the Blanche and Alcmene. At 1 P. M., wind N. by N. fresh gales and squally, with rain. At 6 P. M., E. N. E. At 7, came on a heavy squall of wind with rain, which parted the small bower cable at twenty fathoms from the anchor. At 9, wind N. At 10, N. by W. At 11.30, cut away the best bower at a whole cable and went to sea. Midnight N. E. by N., split the main topmast-stay sail. At 4 A. M. of 11th, strong gales with hard squalls of rain. At 7 carried away the main-staysail. At 8 A. M., wind N. by W. At noon, St. Lucia, N. 19° E., distance thirteen leagues. At 1 P. M. of 11th, wind N. E., very strong gales with hard squalls and rain. From 10 at night till 8 next morning while the storm was most violent the wind was from all quarters. It then became S. S. E and S. E., and so continued till the end of the storm. At noon of 12th, St. Lucia, N. E. by E.$\frac{3}{4}$E. distance eleven leagues.

Log of the Montagu, lying off the entrance of the Careenage, St Lucia.

On P. M. of 10th, wind N., strong gales with heavy squalls of rain and a heavy swell from N. W. At midnight parted or slipped ship Ajax. At 3 A. M. of 11th, slipped and put to sea the ship Egmont. At 5.30, in preparing to slip and put to sea, we parted our stream and small bower cables; stood

out W. N. W. till 8 A. M. South end of St. Lucia then bore S. S. E., nine or ten leagues, wind N. N. E., brought her to with her head to the northward, up N. W., off W. by N., very strong gales. At 1 P. M., wind N. N. E., a very heavy storm, with rain. At 3.30, in cutting the main and fore-topmast, the mainmast, fore and mizenmast, all went over the side; a heavy storm of rain. At 4.15, the bowspit went by the outer gammon, and carried away the greater part of the head. At 6 and 8, wind N. by W., weather the same, and very high sea. At 5 A. M., wind W. S. W. and more moderate. At 9 A. M. saw the Sugar Loaves of St. Lucia bearing E.¼N., distance four leagues; the Island of St. Vincent then E. S. E., distance six leagues. At noon moderate breezes and high sea, cloudy with rain—Sugar Loaves E., distance two leagues.

Log of the Amazon, in the Careenage.

On the afternoon of 10th, fresh breezes with hard squalls. At 6 P. M. the Egmont parted, and brought up again under our stern. At 9, the Ajax put to sea. At 11, the Egmont cut and put to sea; excessive hard gales with rain. At 4 A. M., wind northeasterly, the Montagu parted and put to sea. At 7.30, finding the gale increase, slipped the small bower and stream cables, and cut the best and put to sea. Noon, blowing a hurricane with a heavy sea. At 2 P. M., blowing a perfect hurricane N. E. At 7.30, by the violence of the hurricane the ship overset, and lay in that situation 7 or 8 minutes. At 8, the wind N. W., and ship quite righted with 10 feet water in the hold. At 2 A. M. of 12th, pumps choaked with seven feet water in the hold. At 4 A. M., found the wind abate. At noon, wind N. N. W., gale much abated. In P. M., wind E. by S., first part hard gales with rain. At 5, wind had been quite round the compass in the last twenty-four hours. On the afternoon of 13th, wind still E. by S. with fresh gales and hazy weather with rain. At 6, the body of Martinique E. by S. distance eight or ten leagues.

Log of the Endymion, N. N. E. of Martinico.

On the afternoon of the 10th, wind N. E. strong gales and hard squalls. At 4, saw the N. E. end of Martinico S. W. by S., distance seven leagues. At midnight, strong gales continue. At 8 A. M. of 11th, wind E. N. E. heavy gales and strong squalls. At noon blows strong and violent squalls, N. E. end of Martinico W. S. W., distance four leagues. At 1 P. M., wind E. N. E., strong gales and hard squalls. At 3 A. M. of 12th, just weathered the island of Caraval, the N. E. end of Martinico. At 5, the wind E. At 7, wind E. by N., hove-to under a mizen topsail. At noon, wind E. S. E., continuing a heavy gale and violent squalls.—N. end of Martinico, distance fifteen leagues.

To these particulars extracted from Col. Reid, I am enabled to add the following from the Pennsylvania Gazette of 1780.

Pennsylvania Gazette of December 13, 1780.

At Bridgetown, Barbadoes, (which is on the southwest side) the wind began to blow very fresh soon after daybreak of Tuesday the 10th of October, and increased till 4 o'clock next morning. The wind during the greater part of the hurricane, blew from the N. E. quarter, and never shifted to the southward further than S. E.

From the same paper of December 6.

On the 10th at St. Pierre, on the west side of Martinique, a sudden gale sprung up from N. E., and though the gale increased and continued without

intermission, the shipping kept their stations as the wind blew off the land till the 11th. On the night of the 11th, the wind shifted to the southward, and after continuing there two or three hours, shifted to the S. W. and blew right on shore. Between 2 and 3 o'clock of the morning of the 12th, the sea was thrown into the most violent agitation, and raged with incredible fury and destroyed many houses and stores on the bay.

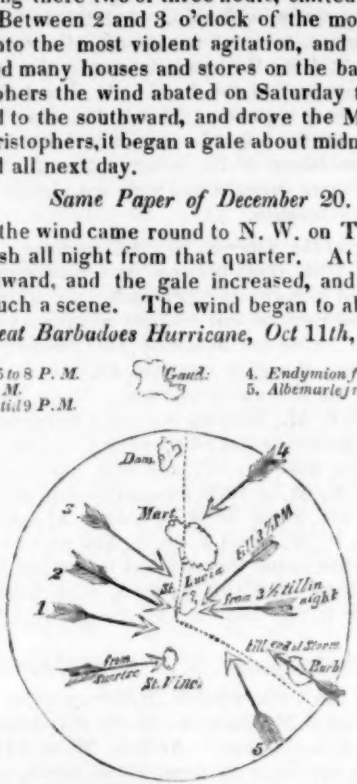
At St. Christophers the wind abated on Saturday the 14th, but about 8 o'clock it changed to the southward, and drove the Minerva on shore. At Bassetere, St. Christophers, it began a gale about midnight of Wednesday the 11th and increased all next day.

Same Paper of December 20.

At St. Vincents the wind came round to N. W. on Tuesday night the 10th, and blew very fresh all night from that quarter. At sunrise it came rather more to the westward, and the gale increased, and from 12 till 4 P. M. there never was such a scene. The wind began to abate at 5 P. M.

Great Barbadoes Hurricane, Oct 11th, 1780.

1. *Montagu from* 6 *to* 8 *P. M.*
2. *Amazon at* 2 *P. M.*
3. *Alcmene from* 5 *till* 9 *P. M.*
4. *Endymion from P. M. of* 10*th to* 12*th.*
5. *Albemarle from* 4½ *P. M. till next day.*



The dotted line is the course which the centre of the storm moved in.

By casting the eye on the map which is intended to represent the locality of the storm at 6 P. M. of the 11th, it will be seen that all the arrows fairly within the action of the storm are directed inwards to a central space of no great magnitude.

This action lasted for several hours of the evening of the 11th; and did not vary until the centre of the storm, towards midnight, passed the Alcmene, the Egmont, and the Montagu, in its motion towards the N. W. And it is worthy of particular remark that as the storm passed on, the wind to all these vessels changed round to the S. E., as it had already done at Barbadoes, and to the Albamarle near Barbadoes.

Now as the centre of the storm passed over or very near all these places, it will readily be perceived that the manner in which the wind changed, accords exactly with the idea, that the wind blows inwards towards the centre of these storms; and not at all with the notion that it blows in the form of a whirlwind. When I take up some of the other storms I shall notice this fact more particularly. I shall only mention here that Mr. Edwards says, in the third volume of his History of Jamaica, that "*all hurricanes begin from the N., veer back to the W. N. W., W., and S. S. W., and when got*

round to S. E. the foul weather breaks up." And Col. Capper in speaking of a great hurricane which occurred on the coast of Coromandel, on the 29th October, 1768, page 60, says "the wind began from the N. W. *as is usual at the commencement of these hurricanes.*"

I shall not give charts of this storm for the subsequent days; but if any one who has Col. Reid's book will read the logs of the Endymion, and the Convert, and the Egmont, and the Diamond, for the 15th and 16th, he will find, if he draws arrows on the charts representing the direction of the wind on these several days, a remarkable convergence towards the centre of the storm. And if he extends his observations to the 17th and 18th, he may include the Grafton with the ships mentioned before. Now as these ships were several hundred miles apart, the evidence is conclusive, that on all these days the wind did blow inwards to the centre of the storm.

But there is one remarkable feature in this storm which must not be passed over in silence. Its centre in its motion turned out of its regular course and passed over Martinique a little after midnight of the 11th. At this time the Endymion, on the N.N.E. of that island had the wind violent from the E.N.E.; and at St. Pierre on the south-west side of the same island the wind was S. W. And the Alcmene some fifteen or twenty miles to the S. S. W. of the island, had the wind S. W. to S. S. W. about the same time for several hours. The intelligent reader will perceive how the wind from the N. E. striking on the eastern side of this island whose mountains are of considerable height, would glance upwards, and thus form a cloud over the island, and thus cause the centre of the storm to locate itself for a time over that island.

Antigua Hurricane of 2 *Aug.* 1837, *at Antigua.*

On the 2nd of August, between 2 and 3 A. M. we had a smart gale from north, which crept gradually round by the north-west, west, and south-west, until it died away in the south-east.

One barometer at Antigua, in the gale of the 2d, only sunk .43, another sunk .63.

At Nevis,

On the morning of August 2d, between 3 and 4, the wind being north, a shower of rain fell. At half-past 6, A. M. the wind began to rise until 8, it then shifted to the N. N. W. and gradually increased in gusts until 10, during which time much rain fell. The wind then veered to the westward, and next to due south, then back to south west, and last backed to south again, from whence it blew steadily and with violence until 2, P. M., when it abated.

At St. Kitts,

Early on Wednesday morning, the 2d of August, the wind blew strong from the north, and indicated the forthcoming storm. At about 8, A. M. it veered to N. W. and shortly afterwards to west, during which time it blew a perfect gale, throwing a tremendous sea into the harbour, and threatening the destruction of every vessel.

At St. Bartholomew,

The storm commenced at north-east, and continued to increase in violence until 2 P. M.

At St. Martin,

A gale commenced about 9 A. M. and raged with great violence from 11 A. M. to 2 P. M., veering from E. N. E. to N. W.

At Santa Cruz,

On Monday the 31st July, 1837, the weather was moderate; several ships

sailed on Tuesday the 1st of August; in the evening the wind was north-east and the weather moderate. On Wednesday the 2d, the wind during the night had shifted to the north; the weather looked squally, cloudy and suspicious, and continued so during the afternoon; the wind shifted gradually to the N. N. W. At 1 P. M. the falling of the barometer, the appearance of the weather, and the increasing wind, left us no doubt of the approaching storm, and it came on from the north-west between 3 and 4 P. M. The mercury continued falling, and the gale increasing, until half past 6 P. M. when the wind became westerly. At 7 P. M. the mercury began slowly to ascend, and yet the storm increased in violence. At 8 P. M. it was blowing a hurricane from the west-south-west to the south-west, coming in furious gusts until 10 P. M., when a certain decrease in their violence had taken place, which abatement continued until Thursday morning the 3d of August, when it blew a fresh gale from the south.

Log of the Water-Witch.

Arrived off St. Thomas on the 2d August; morning squally and the Water-Witch was off St. John's, and standing for St. Thomas's, the wind north and north-north-west. Noon, shipping in the harbour visible; at 1 P. M. squalls violent; at 3 P. M. we had beat up within half a mile of the forts, when we could proceed no further from the violence of the squalls, and anchored in ten fathoms water; sent down top-gallant-yards, &c.; did not suspect a hurricane. At 5 P. M., squalls ceased, and began a heavy gale of wind, at that time off the land. At 7 P. M. a hurricane beyond all description, dreadful; the windlass capsized, and I could not slip my cables, ship driving until I was in twenty fathoms water; a calm then succeeded for about ten minutes, and then in the most tremendous unearthly screech I ever heard, it recommenced from the south and south-west. I now considered it all over with us, for the wind was directly on shore, and the sea rose and ran mountain high. At 2 A. M. the gale abated somewhat, and the barometer rose an inch; at day-light, out of forty vessels, the Water Witch and one other were the only two not sunk, ashore, or capsized.

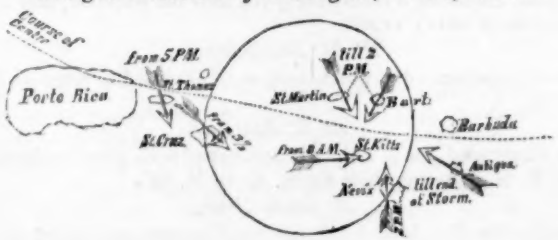
Porto Rico.

At 4 P. M. on the 2d of August, 1837, in consequence of having observed the barometer falling, I ordered all the vessels in the harbour, to prepare for stormy weather, although the fall of the barometer was not great.

At 8 P. M.	the barometer was at		29.6	At 12 midnight,		barometer at	28.00
9	"	"	29.5	1½ A. M.		"	29.17
10	"	"	29.4	4	"	"	29.50
11	"	"	29.3				

At 9 P. M. the wind was strong N. N. E. At 11 veering to east, and blowing in an alarming and furious degree till midnight, when every vessel was sunk or ashore. At 4, the wind fell, and then veered to the south.

Antigua Hurricane of 2d August, P. M., 1837.



It appears from these accounts that the wind, from some time before 2 P. M. till 2, was blowing inwards to a central space between Antigua and St. Martins, from four different localities, Antigua, Nevis, St. Martins and St. Bartholomew.

It is worthy also of particular remark that the barometer fell at Porto Rico to 28 inches, and rose to 29.17 in an hour and a half. As this storm moved about 10 miles in an hour, it would appear that the barometer was lower in the middle of the storm by 1.17 inches than it was at the distance of fifteen miles, and if so, the velocity of the up-moving column in the middle of the storm may be calculated according to the laws of spouting fluids, and will be found to be upwards of 260 feet per second. From this the quantity of vapour condensed in a second may be calculated.

Barbadoes Hurricane of 26th July, 1837. *At Barbadoes,*

At 2 o'clock A. M. of 26th July, light showers of rain, wind shifting from south to north-west, the sky dark and gloomy, with flashes of lightning in the south-east and south-west. At 4, calm with a heavy swell rolling into the bay; lightning and thunder, sky assuming a black appearance, with a red glare at the verge of the horizon; every flash of lightning with an unusual whizzing noise, like that of a red hot iron plunged in water; at 6, the barometer fell rapidly, the sympiesometer much agitated and unsettled, and fell at length to 28.45. At 7.30 the hurricane burst on us in all its dreadful fury; at 8 it shifted from east-south-east to south, and blew for half an hour, so that we could hardly stand on deck—the wind shifting to south-west, at 9 the barometer began to rise, and to our great joy we saw a change in the sky for the better. As the haze cleared away, we counted twenty-one sail driven on shore.

At St. Vincent.

Our paper from St. Vincent informs us that the gale of the 26th July was severely felt there; the wind being from the west and south with a heavy swell of the sea.

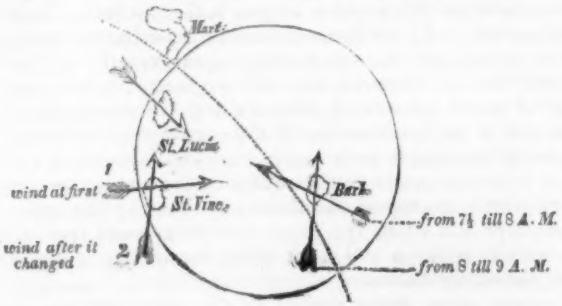
At St. Lucia.

We have experienced a severe gale from the north-west, which lasted several hours.

At Martinique.

Martinique suffered a severe gale on the 26th July, from the south-east. The tempest raged there at 10 P. M., at which hour all was calm at Barbadoes.

When the storm was raging at Martinique, it was calm at Barbadoes. The wind at Barbadoes commenced from the N. W.



It is evident that the wind in all these four storms, blew inwards from the circumference towards a central space of no great magnitude. I shall at some future time examine the other hurricanes in which simultaneous observations can be found, and I hope to show some strong cases in favour of an inward motion. There is one which I have already examined, which is more striking than any of the four here given; I mean that of the 18th of August, 1837. I have been able to add from the American newspapers some observations on that storm, which will render the phenomena much more striking. These observations are copied here for the sake of those who may have Col. Reid's book, who can then examine the storm for themselves.

The Philadelphia Commercial Herald of 28th of August, says "barque King Philip on the 18th of Aug. lat. 31° 12′, long. 78° 16′, gale from N.N.E. to W.N.W.

The same paper of 29th of Aug., says "brig Oglethorpe, on the 18th of Aug. lat. 32° 29′, long. 78° 55′ had a violent gale from N.W."

If the reader will now turn to Col. Reid's account of this storm and mark with his pencil on the chart the direction of the wind on the 18th of Aug., 1837, he will find that the arrows of the following places all point inwards, towards a space where the West Indian and the Duke of Manchester were labouring in the centre of the storm at that time. The Oglethorpe, the Ida, the Rawlins, the Cicero, the Delaware, the Mary, the Westbrook, the Sophia, and at Wilmington. He will moreover observe that the localities are all round the centre, several hundred miles apart, as favourably situated as could be desired for ascertaining the direction of the wind in this storm at a particular time.

The reader will find but two arrows which do not point towards this central space; the Penelope, which seems to indicate a rotation of the wind from right to left; and the Winchester, which seems to indicate a rotation from left to right. These anomalies I hope to explain satisfactorily, and in such a manner as to add a strong link to the chain of argument in favour of an inward motion of the air towards the centre of the storm, if indeed any other evidence, than that of the fact itself, is necessary.

Now if the wind did blow inwards in all these storms, all the phenomena can be accounted for, from the single fact which I have demonstrated from experiment, as indicated in a publication of mine in the Saturday Courier of March 18, 1837.

For as the air must have moved upwards over a central space of undefined magnitude in all these storms, I have demonstrated by experiment that the cold due to diminished pressure, would condense one half its vapour when it reached six thousand yards, a quantity sufficient in ordinary states of the dew-point to produce three inches of rain in that climate. The condensation of this vapour, as I have demonstrated by experiment, would give out into the air in contact with the condensing vapour, caloric of elasticity sufficient to expand that air between five and six thousand cubic feet for every cubic foot of water generated, after making allowance for the diminished volume due to the condensation of the vapour itself into water.

This will cause the barometer to fall more than two inches in the centre of the storm, and to rise all round on the outside of the storm especially on that side towards which the top of the cloud is pressed by the upper current of the atmosphere into which the cloud penetrates—and that will be the direction in which the storm will move along the surface of the earth; all which I have elsewhere shown.

As the cloud moves along, being pushed by the upper current, the air

under the cloud will, on account of the specific levity of the cloud, ascend, and thus the action will be continued. Moreover I have demonstrated from experiment that if the barometer falls two inches under the base of one of these clouds, the air will not have to ascend so high, by eight hundred yards, before it begins, by the cold of diminished pressure, to form cloud—and this in many cases, will bring the cloud down on the surface of the sea; or in other words the vapour of the air in the outside of the storm will begin to condense, as soon as it comes under the base of the cloud, from the cold produced by diminished pressure there.

It is not a little remarkable that all these storms and others which have been traced in the West Indies, traveled towards the N. W. almost at right angles to the direction of the trade wind in those latitudes; but very nearly, if not exactly, in the direction of an upper current of the air, known to exist there towards the N. W. The direction of the trade wind, will therefore produce an oblique force, which will cause the wind to set in at the beginning of these storms, not exactly towards the centre of them, but towards a point west of that centre, and if this single circumstance should be observed without attending to all the phenomena, it would undoubtedly give rise to a suspicion, that the wind in these storms rotates from right to left. And if to this circumstance be added, that these storms are nearly round in this latitude, and that the air at some moderate distance around them is nearly calm, the investigator will be confirmed in his first impression, and perhaps not even think it worth while to mark on his chart, by arrows, the course of the wind in the simultaneous observations at his command. And if to all this is added his belief, that the air in a cloud is denser and heavier than surrounding air at the same elevation, he will consider that it amounts to absolute demonstration, that there must be a whirl, as that is the only possible means of causing a depression of the barometer under all these circumstances in the middle of the storm. Again, if he believes that the cold air from above, coming down in the centre of the whirlwind, which it would do, mingles with the warm air below, and thus produces condensation of its vapour, he thinks he has got hold of a fact, which enables him to explain many phenomena connected with the storm, though the whirlwind itself remains unexplained, as it always must. But if he will examine this subject a little more minutely, he will find, that if air should descend from a height sufficiently great to double its density at the surface of the earth, its dew-point will be raised only 20°, and its temperature by increased pressure above 80°, and that it will then be extremely dry, even if it had been saturated at the commencement of its descent. In fact, it would then be able to contain about eight times as much vapour as it contained before its descent; for at these low temperatures every increase of temperature of 20° doubles its power of containing vapour, as may be ascertained by looking at a table of dew-points. In fact the doctrine of mingling air in the atmosphere to produce cloud, as taught by Dr. Hutton, will not stand the test of examination, even if a means could be discovered of producing the mixture. For it must be done either by cold air coming down, or warm air going up—now if cold air comes down, it becomes intensely dry, and if warm air goes up, it will condense its vapour by the cold of diminished pressure, and more so the less it mingles with the upper air. Nor is the doctrine that cloud is heavier than surrounding air at the same height tenable, as was shown before.

The question then resolves itself into a matter of fact: and a question of great moment it is acknowledged to be—is there a centripetal or a centrifu-

gal motion of the air in these storms? If the former is true, all the phenomena are explained; if the latter, nothing is explained; not even the whirling motion itself. Let the careful reader decide.

[TO BE CONTINUED.]

Mechanics' Register.

List of American Patents which issued in March, 1838.

With Remarks and Exemplifications by the Editor.

74. For improvements in *Apparatus for making Salt;* Charles G. Reynolds, Kanhawa Salina, Virginia, March 3.

The patentee describes the manner of constructing the furnaces and boilers as previously used at the Kanhawa works, and then gives in detail, by reference to the drawings, the arrangements of what he calls "pan pieces," which he employs in lieu of pans; these pan pieces constitute a succession of troughs having a perforation through the partitions by which they are divided, so that when the brine from the settling cistern is let into the upper pan piece, it is filled to the height of the hole in the second, and so on through a succession of such receptacles. The advantages of this arrangement are set forth by the patentee, and a claim made to the special mode of construction described; but without the drawing any attempt at description would claim more space than our readers would wish to have devoted to that purpose.

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75. For a *Bituminous Compound to be used as a Cement;* Cyprian Poullalier, city of New York, March 3.

Since the cement from the asphalte of Seyssel has been attracting public attention, various compositions have been proposed to be made the subjects of patents, as a substitute therefor, most of which have been rejected as being substantially the same with known cements, used in some cases for centuries. That now to be described is to be made in the following manner. For a hundred pounds of the cement, take ten pounds of coal tar; ten pounds of the residuum left after making gas from rosin; twenty pounds of pulverized brick; twenty pounds of the clay of which bricks are made; forty pounds of pulverized stone, gravel, or sand, taking care that when wanted for the finer kind of cement, it be finely pulverized. The whole is to be boiled and well stirred in a cauldron for three or four hours; it is then to be poured into moulds and suffered to cool. When used it is to be melted and laid on in the manner of tar.

The patentee sets forth its good qualities, and then claims "the combination of the materials above mentioned, that is to say, of the residue of coal, which is commonly called coal tar; the residue of common rosin after the gas has been extracted by the usual process; pulverized brick; brick clay; and pulverized stone, gravel, or sand; in the above mentioned proportions, and in the above manner, to produce a cement, or in similar proportions to produce the like result."

We are well assured that a patent was granted for the foregoing in consequence only of the claim being limited to the ingredients specially mentioned,

and in the specific proportions. It appears to be one of those cases where the propriety of granting letters patent is a question of doubt, upon which doubt the decision in favour of the grant rests, the courts being open to the enquiry whether there is any essential novelty in the compound; we think not.

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76. For an improved *Trap for Rats and other Animals;* Thomas Hill, city of Alexandria, District of Columbia, March 3.

This trap is arranged with much ingenuity, but whether the wary animals for whose accommodation it is principally intended, will be inclined to examine its interior is a question to be decided by experience. It has several compartments, the first of which has a sliding door, which rises and falls in the manner frequently adopted in traps; within this first compartment the bait is placed upon a hook, by the moving of which the front doors falls; but the same action opens a passage into a second compartment, the floor of which is a movable platform, or draw bridge, by stepping on which the opening into this second compartment is closed whilst the first slide is raised, and the trap reset. A conical opening of pointed wires, or a sloping fall door allows the rat to advance into a third compartment, leaving the former free for new applicants, and to this third, is attached a fourth compartment, or grand saloon, which may be removed at pleasure, with the animals which may have entered it.

The claim is to "the manner in which the operation of self setting is effected."

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77. For improvements in the *Apparatus for Bleaching Linens, Cottons, &c.;* Samuel W. Wright, a citizen of the U. States, now residing in England; March 3.

"My improvements in bleaching or cleansing linens, cottons, or other fibrous substances, and in the machinery or apparatus for effecting the same; consists, firstly, in the peculiar construction of an air tight vessel in which the goods, or fibrous materials, intended to be bleached, are to be packed in close contact. Secondly, in the manner of passing the alkaline solutions through the compact mass of goods, or fibrous materials, by the agency of steam at a high pressure, which has the effect of opening the fibres of the material under operation. Thirdly, in the manner of rinsing or washing out the alkaline or other chemical matter used in the process of bleaching, by means of high pressure steam. Fourthly, in the manner of forcing the solution of chloride of lime and sulphuric acid through the goods in the bleaching vessel by hydraulic and pneumatic pressure; and, fifthly, in the mode of washing, cleansing, or rinsing the chemical matters from the goods after the bleaching operation has been completed; and, sixthly, in the mode or manner of drying the fibrous goods, or other substances, by passing high pressure steam through them, in a compact state, before removing them from the bleaching vessel, or kier."

This announcement of the objects and general mode of procedure, as set forth in the words of the patentee, will afford a perfectly clear idea of the nature of the invention, and of the kind of apparatus employed; after describing which the patentee says, "It is obvious that the machinery, or apparatus, as above described, may be varied in its form and construction. I do not therefore intend to claim as my invention, the application of high pressure steam to be used with the improved combination and arrangement of the

several parts as applicable to bleaching or cleansing linens, cottons, or other fabrics, goods, or other fibrous substances, as before described."

The process, as described, appears to be eminently well adapted to accomplish the intended purpose in a very perfect and economical manner.

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78. For improvements in the *Machine for Cutting and Dressing Stone;* George M. and John A. Alger, South Stafford, Orange county, Vermont, March 3.

Several patents have been obtained for machines for cutting and dressing stone, and we have been looking for the arrival of one or more of them in Washington, to aid in the preparing of the large quantity of stone employed in building the new Treasury and Patent offices, but not one of them has yet found its way here. Two kinds of stone are used in these buildings, the basements being of granite, and the superstructure of a very friable and porous sand stone; and, certainly, if these machines have not sorely disappointed their projectors, they might be applied to the cutting of the latter, if not of the former.

The claims in the present instance are to "the method of regulating the cutters and frame in which they work; together with the combination of the springs and chisels,or cutter stocks, constructed and operating substantially as herein described." We are appprehensive that the great difficulty in stone cutting machines, is in the cutters themselves, and not merely in the manner of arranging them.

Those which have been patented bear a near resemblance to each other, although they differ in the particular construction of certain parts, upon which the claim to invention is dependent.

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79. For an improved apparatus for *Extinguishing Sparks* in locomotive steam Engines; Jonas P. Fairlamb, city of Philadelphia, March 3.

The claim made is to the particular mode of constructing the apparatus as described, into which description it does not appear necessary to enter, as we are informed that the promised results of "preventing sparks, scales, dust, cinders, or ashes, from going out of chimneys, and *increasing the daught of the same*, so as to facilitate the burning of anthracite and other coal in locomotive and other steam engines," have not followed its use; in proof of which it has been abandoned by the patentee, if a judgment may be formed from his having obtained another patent for a spark arrester.

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80. For improvements in the *Double cylinder Suction and Force Pump;* James J. Rice, Salina, Onondaga county, New York, March 10.

There is sufficient novelty in the arrangement of the respective part of this pump to give it a fair title to a patent on that score; in the points of simplicity, however, it is not to be commended, and in another very important point, that of giving to the water the most direct course, it is signally deficient. Without drawings it would be no easy matter to describe it, and we do not think that the labour would be well bestowed. The claim is to "the before described construction of the pump with the additional outer cylinder; the partitions in the spaces between the outer and inner cylinders, and the form and arrangement of the valves in the circular rims between the said cylinders."

81. For a *Rotary Pounder for washing clothes, &c.;* Christopher Aumock, Elbridge, Onondago county, New York, March 10.

This machine is intended for washing clothes, kneading dough, hulling rice, pounding ores, plaster, corn, oil-cake, &c., and for cutting sausage meat. It consists of a tub placed with the centre of its bottom upon a vertical shaft, and made to revolve horizontally, whilst beaters, pounders, or cutters, placed on the ends of levers, and worked up and down like trip hammers, are to operate upon the materials contained in the tub. The claim made is to "the revolving platform, or tub, in combination with pounders operating substantially as above described."

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82. For an improvement in the *Gimlet;* Ezra L. Hommedieau, Chester, Middlesex county, Connecticut, March 10.

This is said to be an improvement upon Orval Percival's patent gimlet; this gimlet had the pod hollowed down to the point, the screw being formed on the back only; the directions for the improvement are as follows. "After the pod of the gimlet is made and the screw is cut on the back of it, on the left of the centre, at the point of the screw, take out a semicircular piece the depth of one screw, or more, which makes a sharp point, and causes the screw to enter readily, and hold on while it is in the wood. This I claim to be my invention, and of great importance as an improvement on said Percival's gimlet."

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83. For improvements in the mode of *Constructing Locomotive Steam Engines;* Zadoch H. Mann, and Levi B. Thyng, Lowell, Middlesex county, Massachusetts, March 10.

"The nature of our improvements and inventions consists in these particulars. 1st, We construct a fire box with cylinders immersed in water, to prevent them from being fused or consumed by the intense heat of anthracite coal. 2d, We conduct the water from the forcing pumps to a water cylinder, or tube, in the chimney, then take the water from the top of this cylinder, and carry it by small pipes down through the smoke flue, and throw it into the boiler at the forward end. The action of the heat within the flue will make the water hot, if not boiling, before it enters the boiler. 3d, We place the dome within the chimney, and thereby protect it from the external atmosphere."

The claim is in the following words. "What we claim as our invention and improvements are, 1st, The construction of the fire box with separate cylinders immersed in water in the manner described, for burning anthracite or other coal in locomotive engines. 2d, The method of carrying water into the cylinder within the chimney, and conducting it down from the top of the cylinder in contact with the flue, and thereby heating the water to boiling temperature, or nearly so, before it enters the boiler. 3d, The construction of the dome within the chimney, to protect it from the external atmosphere, the whole combined and arranged substantially in the manner herein set forth. 4th, We claim the manner of turning the exhaust steam into the tender, for the purposes set forth."

The lower part of the fire box is made water tight, and within this are placed a number of cylinders, having grates at their lower ends, and being open at top, but so enclosed that the spaces between these cylinders shall be surrounded with water, and shall constitute a part of the boilers.

The boiler is of the ordinary kind, consisting of a horizontal cylinder furnished with draft tubes; on the top of the boiler is constructed the apparatus for heating and conveying the water, &c., which are figured and described. The patentees believe that such will be the saving of heat by this apparatus that only a part of the exhaust steam will be required for increasing the draft in the chimney, and they have therefore devised a mode of carrying it, in any proportion which may be found best, to heat the water in the tender, which apparatus is described and claimed.

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84. For an improvement in *Locks for Guns;* Philo W. Hoyt, Danbury, Fairfield county, Connecticut, March 10.

"The principal improvement in the lock consists in the manner in which I employ a spiral, or helical, spring, as a main-spring, and combine it with the other parts of the lock." This spring is wound upon an arbor, or shaft, which extends through the main plate, and carries the hammer. The coiled spring acts upon the tumbler at one end, and is at the other screwed to a plate on the opposite side of the stock, which is bored through to receive the shaft and its spring. The claim is to "the manner in which I have applied and combined the helical, or spiral, main spring, with the tumbler, hammer, and other parts of the lock."

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85. For an improvement in the *Safety valve for regulating the pressure of Steam in Steam boilers;* John Hadley, Bennington, Gennessee county, N. York, March 10.

Like most of the contrivances for the purpose of showing the pressure of steam, the contrivance here described will fail in accomplishing its object, as its indications are to be given by the sliding of a tube through a stuffing box in the top of a boiler.

There is to be a vertical shaft, or rod, ten feet, more or less, in length. The lower end of this rod is to be cylindrical, and tubular, opening into the boiler, and working in a stuffing box. This rod is to be pressed upwards by the expansive force of the steam, and when it rises to a certain height, so as to bring a lateral opening into its tubular part, above the boiler, the steam will escape through it. The upper end of the rod acts upon a horizontal shaft turning on gudgeons, and carrying an index at one end, to point out the degree of pressure. This shaft also raises a weighted arm, or lever, which may be loaded in any degree desired, by the shifting of the weight; said arm, or lever, hangs vertically when there is no pressure of steam. The claim is to "the manner of showing the degree of pressure of steam, and the manner of giving vent to the steam, at the pressure desired, in combination, as above described." There is not any thing in *the manner* of constructing this apparatus to redeem it from that failure which has been the doom of several analogous contrivances. It is not possible to cause a piston to work steam tight, and with an equable resistance at all times, through a stuffing box; nor does this device touch the main cause of steam boiler explosions, namely, a sudden generation of steam, in which case the sliding shaft would be of no more avail than it would be if applied to a piece of ordnance.

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86. For a *Machine for smoothing Type;* David Bruce, Jr., Bordentown, county of Burlington, New Jersey, March 10.

87. For a *Machine for Casting Printing Type;* David Bruce, Jr., Bordentown, county of Burlington, New Jersey, March 10.

The two above named machines do not admit of description without the accompaniment of illustrative drawings. To these the claims refer, and they would not, therefore, alone, convey any adequate idea of the machinery patented.

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88. For an improved *Cooking Stove and Oven;* John R. Smith, New Haven, New Haven county, Connecticut, March 10.

An oven, the outer casing of which is double, so as to admit heated air to circulate around it, is connected by means of a pipe with a cylindrical or other stove, so that the heated air from the latter may heat the former; there is not any thing of a very special character to present, and the claim made is confined to the manner of constructing and combining with a stove of any suitable kind, an oven formed and operating substantially in the manner set forth.

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89. For an improvement in the mode of making *Cast Iron Wheels for Cars,* to be used on rail-roads, and applicable also to other purposes; Henry Mooers, Beaver Meadow, Northampton county, Pennsylvania, March 10.

The claim under this patent is to "the mode of chilling the hubs, by means of the combined chills, so as to make a car wheel with a solid hub, without their straining, or being liable to break."

As this patent has been virtually repealed by the decision of a special board of examiners under the provisions of the patent law, who have ordered a patent to issue for the same thing, to Mr. Hopkin Thomas, of Beaver Meadow, who was, in the opinion of the board, the original and first inventor, we shall not give a description of the thing patented until we arrive at that of Mr. Thomas, in due course.

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90. For a *Machine for Sawing Eave Troughs,* for conducting water from buildings; Jira Wing, Hancock, Addison county, Vermont, March 17.

Two circular saws are to be placed upon shafts, so as to stand at right angles, or at any other suitable angle, from each other, and to meet, or nearly so, at their edges; these saws are to be driven by suitable gearing to cut the stuff from which the trough is to be made, said stuff being supported on a suitable carriage.

The particular construction of this machine is a point of little importance, as any handy machinist would be able to make one, without any further information than that above afforded. The claims made are to "the arrangement of the saws in their respective frames; the method of setting and regulating the saw frames, the combination of the two saws; and the method of operating the carriage, all as described."

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91. For a *Revolving Spring Punch;* Solyman Merrick, Springfield, Hampden county, Massachussetts, March 17.

This punch is for making holes in leather, and is made in some respects like the ordinary spring punches for that purpose, that is, with two handles,

and a spring to open them, like sugar nippers. Instead of a single punch screwed into one of the jaws, and made to act on a strip of copper on the opposite jaw, there are several punches, usually four, of different sizes, which are screwed into a hollow hub, and stand out like radii, or the spokes of a wheel. This hub is received into one of the jaws, within which it revolves, thus allowing either of the punches to be brought into the position for cutting against the antagonist jaw. That which contains the hub, is slit, so as to constitute spring cheeks, having hollows to embrace the sides of the punch in use, and hold it in its place. We have one of these instruments, and find it convenient for various purposes; the four sizes of holes are obtained instantaneously by merely turning the punches round, and it is altogether a very neat and pretty article. The claim is to "the combination and arrangement of the elastic shanks, or sides, of the lever, and the circular grooves, or catches, as set forth."

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92. For an improvement in the mode of making *Cast iron Car Wheels*, to be used on rail-roads, and applicable to other purposes; Jonathan Bonney, Charles Bush, and George C. Lobdell, Wilmington, New Castle county, Delaware, March 17.

(See Specification.)

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93. For an improvement in the *Self-Sharpening Plough;* John Ormiston, Center, Morgan county, Ohio, March 17.

The claim under this patent is to "the peculiar form and construction of the double point, and the mode of fastening it, as described."

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94. For a machine for *Punching and Shearing Iron;* Lemuel T. Pope, Boston, Massachusetts, March 17.

There is nothing worthy of special notice in this patent, which is taken for combining together the common shears for cutting sheet metal, and a punch for punching holes therein. The claim is to "the combination of levers, and the arm and follower, as set forth."

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95. For an improvement in the mode of making *Cast-iron Wheels to be used on rail-roads*, and which are applicable to other purposes; Samuel Truscott, George Wolf, and James Dougherty, Columbia, Lancaster county, Pennsylvania, March 17.

(See Specification.)

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96. For an improvement in the *Platform Balance for Weighing*; B. Morrison, Milton, Northumberland county, Pennsylvania, March 17.

The numerous modes in which platform balances have been modified appears to leave little room for any great change in their construction; and it seems to us that there is but little to be desired, those which are in use being, in many instances, equally convenient and accurate. The claim in the present case is to "the application of the parallel principle to a lever of the second kind, (viz. to a beam having its weight between the fulcrum and the power) for the purpose of weighing; and the combination described whereby the points or edges of the main lever are at any time capable of

being freed from the pressure of the platform and what may be laid thereon, and the platform at the same time be made to rest firmly and securely upon the supporters, or posts, beneath the same."

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97. For an improvement in the machine for *Crimping leather Boots;* Collins H. Jaquith, Keene, Cheshire county, New Hampshire, March 21.

This machine very closely resembles some others previously patented. The leather is placed on a former, upon which it is to be crimped by causing it to be pressed in between two jaws, which are furnished with thumb screws to regulate their distance apart. These, and a strap attached to a ratchet wheel to strain the leather upon the former, constitute the novelties claimed.

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98. For a mode of preparing a *Composition for Fuel,* by the aid of calcareous cements; John Allen, city of New York, March 17.

(See Specification.)

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99. For an improvement in the *Furnace and Pots for Melting Metals;* Silas Grilley, Waterbury, New Haven county, Connecticut, March 17.

(See Specification.)

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100. For improved *Backs for Forges and Furnaces;* Luke Wilder, Leominster, Worcester county, Massachusetts, March 17.

This forge back is to be of cast-iron, and is to be perforated so as to receive a cast-iron tube, which is to constitute the aperture, through which the wind is to be blown. Two, three, or more tubes of different sizes may be adapted to the same back, and be changed according to the nature of the work to be done. Particular directions are given respecting what is deemed the best form of the respective parts, and a claim made to "the back, and the tubes, and the form thereof, their adaptation to each other, and their uses, as set forth."

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101. For improvements in the *Furnace for Smelting Iron with Anthracite;* Joseph Baughman, and Julius Guiteau, of Mauch Chunk, Northampton county, Pennsylvania, March 21.

(The Specification will appear hereafter.)

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102. For an improvement in the *Fishing Sein for deep water;* Russell Evarts, Madison, New Haven county, Connecticut, March 21.

This patent is taken for a particular form of sein, in combination with the boats and floats, arranged and employed in the manner described, for the purpose of fishing in deep water. The subject matter is not of that general interest to justify the long detail which would be necessary in order to describe the affair, without a drawing; few fishermen, we apprehend, read our lucubrations.

103. For improvements in the mode of making *Metallic Pens, or instruments for writing;* Henry C. Windle, Joseph Gillott, and Stephen Morris, of the kingdom of Great Britan, March 21.

The claims under this patent are to "the elastic and adjustable finger and thumb plates, whether applied to pen holders, or pens, or other such instruments for writing. The introduction of the double arch, one in each nib of the pen, in manner, and for the purpose described.—The new channel pen feeder, made separate from the pen, and attached thereto when in use, by means of a slide ring, for supplying ink to the point of the pen, as described." The things set forth are illustrated by nineteen separate figures in the drawings. The finger and thumb plates have a curious appearance, projecting out from the penholder something like the keys of a flute; we think it very probable that a little practice with them may prove them to be useful contrivances, although they may at first be used as awkwardly as a knife and fork by a savage. These and the other things claimed will undoubtedly soon find their way into the market, should they prove to be good, as Windle and Gillott's pens, are every where to be found.

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104. For improvements in the mode of making *Spiral Springs for belts, pantaloons, vests, &c.;* Walter Hunt, city of N. York, March 21.

Flat spiral springs are to be formed by winding steel wire round a piece of hoop iron, or other suitable former; the coils of these springs are to be about one fourth of an inch apart, and the two ends of the wire are to be bent so as to "form hooks and tongues." "In this last forming of the tongues upon the opposite ends of the spring consists the novelty and utility of the invention, inasmuch as it affords the most simple and advantageous means of attaching the spring to straps, &c., in such manner that it may act by extension, and perform the twofold office of spring and buckle."

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105. For a machine for *Thrashing grain, hulling clover seed, shelling corn, and for other purposes;* Horatio N. Waterhouse, Butler county, Kentucky, March 21.

The novelty in this apparatus consists in placing the concave of a cylinder thrashing machine upon a movable apparatus, so that by raising or depressing a bar, it may be brought nearer to, or removed further from, the revolving cylinder, and be thus adapted to the performance of the respective operations. The claim is to "the movable bar of the concave for regulating the feed of the machine, for shelling corn, hulling clover seed, or thrashing grain.

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106. For improvements in *Boxes and Axles for Carriages;* James A. Smith, New Haven, Connecticut, March 23.

"The object of this invention is to lessen the friction, or to prevent oil from escaping. This I effect by making a friction washer, and thereby an oil preserver, a constituent part of the box on the outward end, instead of the common friction washer on the axle at the other end of the box."

What is called a friction washer is an interior flanch on the front end of the box, forming a shoulder against which the shoulder on the end of the axle is to press, and leaving an opening in the box sufficiently large for the screw

on the end of the axle to pass through, which is to receive the nut. The claim is to "the friction washer within, and making a constituent part of the box, and the corresponding shoulder on the axle, as specified and described."

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107. For an improved machine for *Excavating and removing Earth, in making Prairie fences;* James Sawyer, city of N. York, March 23.

In this machine the turf and earth are to be cut by a plough attached to a carriage drawn by animal power; from the plough the turf is to pass, unturned, upon an inclined endless apron, driven by the friction of the upper edges of the driving wheels; this endless apron is called the elevator, and from this the turf is to be delivered on to a second endless apron called an inclined plane, extending out to a considerable distance behind the elevator, and behind this is what is called the delivering plane, which swivels so as to carry the turf out of a direct line, and delivers it where it may be required.—The plough is to cut "a close furrow (say eighteen wide and five thick)" [inches we suppose]. The claims are to "The delivering plane and its arrangement, for depositing the turf upon the fence at any required height. The arrangement by which the inclined plane vibrates, so that the turf can be delivered upon the fence, although the main carriage and plough may be running twenty feet distance from it. The combination of the endless chain or band with the delivering plane and the excavator or elevator in the manner above described."

The description of this apparatus is very far from perfect, and appears to have been prepared before the actual trial of any such machine. This observation is founded on a conviction that a machine made from the description would not operate; its heavy load, and the manner of its transition being such as to produce a resistance which no animal power would advantageously overcome.

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108. For improvements in the mode of constructing a *Double hill side plough*, and converting the same into two single ploughs; Martin Rich, Ithaca, Tompkins county, New York, March 24.

"This hill side plough is of the kind which has two perfect mould boards and land sides connected together by their upper sides, or standards, and which are to be inverted in alternately passing backward and forward in the act of ploughing; but they are so constructed that they may be readily separated, leaving a perfect single plough; and forming a second by attaching the removed portion to another beam and handles prepared to receive it." The claims made are to "the manner of holding and securing the shifting handles by means of the arm; the manner of confining the two standards in the beam by means of a staple and wedge as described, and the converting the double into two single ploughs as described."

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109. For an improvement in the *Shot charger*, for measuring shot in charging guns; George W. Dobbins, city of Baltimore, March 23.

The claim made is to a "mode of measuring the charge in such way that all except the quantity requisite to constitute the charge shall run off and be separated from the charge; and the mode described of discharging the shot at once into the barrel of the gun, in connexion with the application of the principle above mentioned."

The plan is simple, and must answer the purpose intended. The shot bag fills the charging tube, as it hangs over the shoulder, the shot running into it through a lateral tube leading from that forming the mouth of the bag. When the shot bag is turned up for the purpose of charging, all the superfluous shot runs back into it by the same opening through which it entered; that constituting the charge remaining in a chamber below the opening; when the mouth of the charger is placed over the muzzle of the gun, and a valve opened by a thumb piece, the shot will fall into the gun by their own gravity. The instrument is made adjustable.

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110. For improved *Parlour and Kitchen Fire places;* John Hagerty, Monroe, Monroe county, Michigan, March 24.

This apparatus is represented in several drawings,and the claim is to certain special arrangements, not to be briefly described; in such cases, where engravings or cuts are necessary to the description, they will always be willingly inserted in this journal, should those interested think proper to supply them.

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111. For improvements in the machine for *Crimping Leather for Boots;* Joseph Adams, Fairhaven, Rutland co., Vermont, March 26.

This machine resembles that noticed at No. 95; but the jaws are used in a reversed position, and there is a difference in their manner of combination.

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112. For a machine for *Pricking Leather preparatory to stitching;* J. W. Briggs, and J. S. Carver, Painsville, Geauga county, Ohio, March 26.

The leather to be stitched is placed between the jaws of clamps, which clamps are attached to a slide at their lower edges. This slide is guided by grooves, and is made to advance by means of a rack and pinion, the latter being turned by a treadle similar to that frequently employed for holding the clamps together. The feeding is graduated by a ratchet wheel and pall, and as the clamps advance, the same treadle brings up an awl which pricks the leather, which awl is retracted by a spring. The claim is to "the method of pricking the holes by means of a sliding awl, operating in the manner substantially as above described; and the method of working and regulating the motion of the sliding clamps in combination as above described."

We think this claim good, but believe that it might, with safety, have been made still broader, including not merely the method described of working the sliding clamps, but the sliding clamps themselves, as we believe this to be a novel feature in Harness maker's clamps.

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113. For an improvement in the *Mode of applying Friction rollers;* Rollin Dickinson and Samuel G. Merriman, Southington, Hartford county, Connecticut, March 26.

"We do not claim as our invention, friction rollers as such; but we do claim as our invention and improvement the mode of supporting friction rollers in a tight box filled with oil, and working them in oil covered from dust or other foreign substances, as specified."

The gudgeons of the friction rollers run in a frame which is to drop into

an oil box reaching above these gudgeons, but not so high as to interfere with the bearing of an axle upon the peripheries of the friction wheels. Over the whole is to be a close fitting cover.

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114. For an improved *Porcelain or Earthenware Stove;* Joseph Smolenski, city of Philadelphia, March 28.

This stove is intended as a modification of the earthenware stoves used in Europe. The patentee says, "I do not claim to be the inventor of stoves of porcelain, or other kinds of pottery, nor of the device for establishing an upward and downward draught alternately; this having been frequently done in stoves formed of metal, but not, as I believe, in the manner herein set forth in such as have been formed of pottery. I claim as of my invention the forming the body of a stove of the kind herein described, of plates, or pieces of pottery of different thickness, duly graduated according to the pressure and temperature as set forth. I also claim the construction and use of the air tubes, made and operating as described."

There is much similarity between this and some of our iron stoves, as will appear from the foregoing. Our habits appear to be adverse to the employment of a more fragile material, and we very much doubt the success of an attempt to introduce those of earthenware into general use, and are not certain that the balance of advantages would be in their favour, upon a strict investigation of the merits of both.

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115. For an improved *machine to set saw teeth;* Norman Billington and Dyer Hutchins, Shaftsbury, Bennington county, Vermont, March 28.

The parts of this saw-set appear to be arranged in a novel manner, and the claims consist in "the combination of the jaws as described, with the handles, and the application of the same to the purpose of setting saws."

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116. For improvements in the mode of making *Metallic Combs;* Richard A. Ives, Bristol, Hartford county, Connecticut, March 28.

Metal combs in various forms and modes of construction have been the subjects of patents; in the present case the manner of construction is best adapted to those of the small tooth; the claim to novelty rests upon the manner of putting the pieces of metal, forming the comb, together. Sheet metal (German silver being preferred) is to be rolled to the thickness the tooth is intended to have, and this is to be cut into strips which are to be long enough for the length of a tooth and the width of the solid rib running along the middle of the comb. The strips so cut are to be placed side by side, lapping upon each other at their interior ends, so far as is necessary for the width of the rib; suitable pieces for end teeth are then added, and the whole are to be soldered together. Thin plates of the same metal, the length of the comb, and width of the rib, are to be soldered over the laps, on each side, and the comb to be worked off, and polished. Where but one row of teeth is desired, the ends of the strips are to be doubled over, to such length as shall equal the width of the back, which is then to be finished in the same manner with the double toothed comb.

The claims are to the mode of forming the ribs, or backs, of combs, and the strengthening them as above described.

117. For an improvement in the *Hydrostatic Press;* Edward Merrill, New Bedford, Bristol county, Massachusetts, March 24.

This patent is taken for the manner of constructing the frame work of the press, and the patentee says that the advantages possessed by his press over others, are that "they cost only about one-third as much as the hydrostatic presses now in use; inasmuch as it requires about 4,000 lbs. less iron to make one, and obviates the necessity of more than one pump for several presses; it takes up less room, and answers a better purpose." He then claims "the mode of connecting the piston with the follower, in the manner described." The particular mode of construction cannot be well made known without the drawings and references.

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118. For a *Machine for Carrying Straw from Thrashing Machines;* Uriah Beebe, Clarendon, Orleans county, New York, March 28.

This machine consists mainly of a number of revolving shafts crossing a trough, and carrying each a double row of long teeth, or fingers, which are to reach out nearly to the contiguous axles, and to pass between the teeth projecting from them. These being driven by suitable wheels and bands, or otherwise, take the straw in succession, carrying it from the thrashing machine to such distance as may be required. The grain is to pass through a screen, near to the thrashing machine. The claim is to the mode of carrying the straw, as described.

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119. For improvements in the machine for *Making Wrought Iron Spikes and Nails;* Richard Savary, Pittsburgh, Pennsylvania, March 28.

This patent is taken for the particular manner of arranging and operating the respective dies, and to this the claims are confined. These are not matters for verbal description.

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120. For an improvement in the *Straw Cutter;* William J. Duvall, city of Baltimore, March 28.

In this machine the feeding trough is made in the ordinary way, and the straw is to be cut by a knife working up and down at its fore end. This knife is moved by a particular combination of levers, which serve also to govern the feeding apparatus, consisting of rollers moved by a ratchet wheel and feed hand. The claims are to the particular manner of arranging and combining these parts.

Specifications of American Patents.

Specification of a Patent for Cast Iron Wheels to be used on Rail roads; Granted to Samuel Truscott, George Wolf, and James Dougherty, *Columbia, Lancaster county, Pennsylvania, March* 17, 1838.

To all whom it may concern, be it known, that we, Samuel Truscott, George Wolf, and James Dougherty, of the Borough of Columbia, in the county of Lancaster, and State of Pennsylvania, have invented a new and improved mode of constructing cast iron wheels for rail-road cars, and for

other purposes; and we do hereby declare that the following is a full and exact description thereof.

We denominate our wheel, the *Double Plate Car Wheel*, because we use two plates, instead of the spokes, or arms, usually employed, which plates are cast with the rim, and form one substance therewith. We give to the rim of our wheels the same form in all respects as is now given to the rims of car wheels, but instead of arms we cast our wheels with two parallel, or nearly parallel, plates, which plates are convex on one side, and concave on the other; the hub, or nave, which is to receive the axle, is cast in the centre of these plates, extending from one of them to the other. The accompanying drawing gives a sectional view of one of our wheels, *a*, *a*, being the rim, *b*, *b*, the front and back plates, convex on one side, and concave on the other; *c*, *c*, being the hollow, or void space between them; and *d*, *d*, the nave, or hub. The hollow *c*, *c*, between the two plates is formed by a core, in the process of casting, which core is supported in the flask by leaving suitable holes in the plates for that purpose, which serve also for the removal of the sand of which the core is formed.

We cast our rim in a chill, in the usual manner, and in consequence of the particular form given to the plates, they contract in cooling without danger of fracture, and without its being necessary to divide the hub, as is done when car wheels are cast with spokes, or arms. The only effect of contraction is to flatten the two plates in a slight degree, operating in this respect like the curved arms of many cast-iron wheels.

We are aware that car wheels have been made with plates as a substitute for arms, but such plates have been made separate from the wheels, and united together by screw bolts, embracing the hub in a distinct piece between them. The difference between such wheels, and those constructed by us, is so obvious as not to need pointing out.

What we claim as our invention, and wish to secure by letters patent, is the manner of constructing wheels for rail-road cars, or for other purposes to which they may be applied, with double convex plates, one convex outwards, and the other inwards, and an undivided hub; the whole cast in one piece, as herein fully set forth.

Samuel Truscott,
George Wolf,
James Dougherty.

Specification of a Patent for an improved mode of preparing a Composition for Fuel, by the aid of Calcareous Cements. Granted to John Allen, *City of New York, March 17th,* 1838.

To all to whom these presents shall come, Be it known, that I, John Allen, of the city of New York, in the county and state of New York, have invented a new and useful composition of matter, to be used as fuel, and to be called *compound coal*, and that the following is a full and exact description thereof:

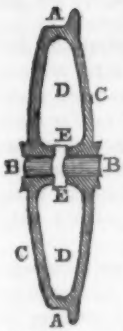
Take from eighty to ninety parts of coal dust or fine coal, such as makes from handling, breaking or sifting the anthracite or hard coal, or the dust of pit coal, with from ten to twenty parts of ground plaster or gypsum, as prepared for use as cement, and water sufficient to mix them to the con-

sistence of thick cream; then expose the mixture to the operation of a press, or to the air and sun, and in a few moments it will be sufficiently firm and dry to bear transportation. Immediately preceding the hardening of the cement, it may be easily cut into blocks or squares of any size or shape, with knives, or with a machine constructed for that purpose. As the cementing power of the plaster is expended very suddenly, and within one or two minutes after the water is applied, it is highly important, indeed, absolutely necessary, that the mixing should be performed with haste, so that it may be spread out and made level and smooth, ready for the press, or the cutting machine, at the critical moment. The time indicated for the application of the cutting knives or machine, by the appearance of the mixture, is by its assuming a rough appearance on the surface, by dropping into little holes as the water disappears. If the mixture is stirred or disturbed during the expenditure of the cementing power, it leaves it in mortar, and is unfit for use unless it is submitted to a heavy pressure, and exposed to the sun and air. Another form of the compound, is by the use of lime in the above proportions, instead of plaster. In which case less care is required in the process of compounding,—the cementing properties of lime being much slower and less powerful,—and therefore requiring more pressure, or if dried by evaporation, more air and sun. Another form is prepared by a combination of plaster and lime in various proportions, according to the power of the press, or the dryness of the atmosphere—the increase of plaster requiring less of either—the increase of lime requiring an increase of both. Another form is prepared by any of the above proportions, by adding to the coal dust from ten to twenty per cent. of the dust of Liverpool coal or other bituminous coal. Another form is prepared by the use of the above proportion of coal dust, in combination with from ten to twenty per cent. of cement, such as is used generally in hydraulic structures, and prepared in a variety of ways. This compound is ignited and used as any of the hard coals are used, as fuel. The inventor, in this case, *claims* having discovered, that the dust of hard coal, peat coal, or bituminous coal, may be, by combining it with *plaster*, or *gypsum*, or with *lime*, or with *cement*—or with *plaster and lime*, or with *plaster and cement*, or with *lime and cement*, in the proportions of from eighty to ninety per cent. of dust, with from ten to twenty per cent. of the other enumerated articles—may be put into such form, and by evaporation or compression, or by both, have imparted to it such solidity and other requisite qualities for transportation and combustion, that it may be used as fuel in any and in every machine in which coal is generally used.

JOHN ALLEN.

Specification of a Patent for an Improvement in the mode of making Cast-Iron Wheels for Cars, to be used on Rail Roads. Granted to JONATHAN BONNEY, CHAS. BUSH and GEO. G. LOBDELL, *Wilmington, New-Castle County, Delaware, March 17th,* 1838.

To all whom it may concern: Be it known that we, Jonathan Bonney, Charles Bush, and George G. Lobdell, of Wilmington, in the county of Newcastle, and state of Delaware, have invented an improvement in the manner of constructing cast-iron wheels for cars, to be used upon rail roads, and for other purposes; and we do hereby declare that the following is a full and exact description thereof. The accompanying drawing shows a section of one wheel, which, instead of arms as usually employed, has each face thereof convex, a hollow space being left between the two surfaces.



The rim of the wheel A, A, does not differ from those usually employed, and is cast in a chill in the ordinary manner. The rim is united to the centre, or hub, of the wheel B, B, by the two convex face plates C, C, which are cast in one piece with the rim and hub. The interior D, D, between the two convex face plates, is formed by cores, supported in a way well known to iron founders. The hub has a transverse division E, E, which separates it into two distinct parts, attached respectively to the face plates. This division is necessary to prevent the tension which would be produced by shrinkage in the casting, and which would endanger the breaking of the wheel. The hub, if preferred, may be cast solid, with the exception of the division E, and afterwards bored out; or it may be cored, and turned to receive the axle.

We are aware that wheels have been made with double convex plates, both of cast, and of wrought iron; but such plates were in separate pieces from the rims and hubs, being received into rebates on the rims, and embracing the hub between them, which extended through openings in their centres, the two plates being secured together by screw bolts; we are also aware that a plan has been devised for cast iron wheels with two face plates, having a space between them formed by cores, as in our method, but the two plates were in this case parallel to each other, one of them being convex, and the other concave, on its face, the hub extending from one face to the other in a continuous piece, rendering it necessary, on account of shrinkage, to place the two plates as described; an arrangement which sacrificed strength to necessity.

By constructing the wheel so that the plates shall both be convex outwards, as they are, in the position of the greatest strength, they may be made considerably thinner than would otherwise be admissible, and the wheel will consequently be lighter.

All that we claim as our invention, is the division of the hub into two parts, transversely, between two face plates, each convex outwardly, in the manner, and for the purpose, set forth.

Jonathan Bonney,
Charles Bush,
George G. Lobdell.

Specification of a Patent for Improvements in the Furnace and Pots for Melting Metals. Granted to Silas Grilley, *Waterbury, New Haven County, Connecticut, March 17th,* 1838.

To all whom it may concern: Be it known, that I, Silas Grilley, of Waterbury, in the county of New Haven, and state of Connecticut, have invented a new and useful improvement in the furnace and pots for melting metals for castings, or for other purposes, by which great saving of metal, of fuel, of time, and of labor, is obtained.

This I effect by appendages, simple in construction, and easily applied to furnaces and pots in common use.

To enable others skilled in the art, to make and use my invention and improvement, I describe the construction and operation as follows, viz:

The furnace may be round, or square, and of a size suitable for the pots intended to be used, and must be lined with fire brick, or other material, indestructible by fire, and having a grate at the bottom, the middle bar of

which should have on it an elevated stand about an inch high, for the pot to rest upon.

The pots I use may be of any size, and for large or small operations, and are in the common form, except that they should be made without a projecting lip, and of the materials in common use, or of any other that will stand the fire: and my improvement consists, principally, in placing on the melting pots, a top pot, or tube, open at both ends, about one-fourth longer than the bottom pot—in diameter, of the size of the lower pot where they join, and a little less at top, having a shoulder with a lip at the bottom, to fit, embrace, and rest upon the top of the lower pot, and is made of the same materials as the lower pot.

The object and peculiar use of the top pot, or tube, is to enable the operator to charge both pots with metal sufficient, when fused, to fill the lower pot as it melts and descends; thus preventing the necessity of opening the furnace to introduce cold metal, and the waste of time occasioned thereby; and while the fuel in the furnace surrounds both pots on the outside, all coal may be excluded from the inside of both.

The furnace may be covered with folding doors, closing around the upper pot, or tube, or it may be held steady in place, by a ring around the tube, having branches hooked to the sides of the furnace. The top of the tube may be covered with a movable lid, to exclude coal when feeding the furnace.

My object is to confine the heat, and to give easy and direct access to the lower pot for the occasional supply of metal when necessary for compounding, or otherwise, without interfering with the fuel, and to prevent the waste of metal by such interference, and the loss of time and labor by the usual mode of feeding.

After the metal is all fused, the top pot, or tube, may be taken off, and a flaring piece or hopper, having an open orifice in the centre, of the size of the melting pot, made of the same materials as the pots, and fitted with a lip, to the top of the lower pot, and flaring upwards nearly to the sides of the furnace, may be placed upon the top of the pot, thereby confining the heat around the pot and preventing the loss of metal by swashing, while stirring the melted mass to mix and amalgamate the metal—a necessary operation, and often attended with loss.

I claim as my invention and improvement:

1st. The upper pot, or tube, as described, and its application and uses for the purposes specified.

2d. I claim the flaring piece, or hopper, as described, and for the uses and purposes as specified;—and for these improvements severally, and for each in combination with furnaces and pots for melting in common use, as specified, I solicit letters patent.

SILAS GRILLEY.

On uniting the Leaves of Books by means of Caoutchouc, instead of by Stitching, in the ordinary manner.

We some time since published the specification of a patent for an invention made in England, consisting in the employment of caoutchouc varnish for uniting the leaves of books, instead of by sewing. It seems just and proper to give publicity to the following report, as containing, it is believed, the original suggestion of this process. There is not any idea entertained

that the invention in Great Britain was not also original, as there was not any extended publicity given to the process of Mr. Breed.

Hall of the Franklin Institute, Philadelphia, January 8th, 1835.

The committee on science and the arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, to whom was referred for examination, a method of bookbinding, invented by Mr. Samuel D. Breed, of Philadelphia:

Report, that this invention consists in the application of a cement or paste, made by dissolving gum elastic in an essential oil, to the back of the book, so as to supersede the necessity of stitching. To effect this the folds at the back of the book must be shaved off so as to lay the edges of all the leaves bare, and the cover of the book applied and cemented with the solution of gum. The advantage which Mr. Breed expects to derive from this invention are, diminished cost of binding, greater durability in consequence of the elasticity of the back, and greater fitness for re-binding, as the gum cement will occupy much less of the margin at the back than stitching does.

The few and imperfect experiments made by Mr. Breed, do not furnish to the committee sufficient ground for an opinion relative to these supposed advantages. But they observed a peculiarity in the book exhibited to them which deserves especial notice, which is, that the book would lie open at any page without constraint, in consequence of there being no stitching to cause its leaves to spring together.

The committee are inclined to believe that when properly matured, this may prove to be a valuable improvement in the art of bookbinding, and therefore advise Mr. Breed to test its utility by further trials.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

Progress of Practical and Theoretical Mechanics and Chemistry.

Kyan's Patent for Preventing Dry-Rot.

Having been prevented attending at the opening of a fungus pit in the Anti-Dry-Rot Company's Yard, David street, on Wednesday last, we take the following account from the *Manchester Chronicle* of Saturday:

"Amongst the articles placed in the pit [Nov. 7th, 1837,] were various kinds of timber in thin boards, prepared with the anti-dry-rot solution, ropes, twine, sacking, and canvass; and articles in an unprepared state, but corresponding in every other respect with those which were prepared, were also deposited therein, in order that the action of the anti-dry-rot process might be the more satisfactorily shown. The pit was closed in the presence of several gentlemen who signed a certificate to that effect, and the key of the padlock by which it was secured was placed in the hands of Mr. Hawkshaw, of the Bolton Railway. On Wednesday last, the 7th instant, the pit was opened in the presence of a numerous body of gentlemen, amongst whom were Samuel Evans, Esq., the boroughreeve, George Wood, Esq., and J. Woollam, Esq., the constables of the town, several eminent architects and builders, including Mr. D. Bellhouse, jun., Mr. T. W. Atkinson, Mr. Tattersall, Mr. Wallis, and Mr. Edwards, and many gentlemen who felt interested in the success of the experiment. It may be necessary to state, perhaps, that the bottom of the pit was thickly strewn with pieces of wood, which the dry-rot had reduced to a state of decomposition, and every facility

was given, in the manner in which the articles were deposited, for communicating the infection to the prepared as well as to the unprepared. The result, we are happy to say, was quite as successful as could have been anticipated by the parties who made the experiment. With respect to the timber, which consisted of spruce deal, soft American elm, poplar, American ash, American birch, and American oak, the boards which had been submitted to the Kyanising process were found to be perfectly sound and untainted, while those which were unprepared exhibited in various degrees the progress of the disease. The American oak, in particular, afforded most satisfactory proof that the value of the process has not been overrated. The prepared plank was of a fine dark colour, without the slightest symptom of decay, while the unprepared was rotting away most rapidly. A piece of very coarse wrapper, such as is used for nail-bags, was reduced to a state of decomposition, while the corresponding piece, which had been Kyanised, was sound in every part except at the edges, where it is supposed it had not been properly saturated. Another specimen of wrappering, and some soft packing-rope, unprepared, were completely decayed, while the corresponding pieces were as sound and perfect as on the day they were put into the pit. Two balls of thin twine exhibited the effects of the principle perhaps more forcibly than any of the other articles, the unprepared being reduced to a lump of manure filled with small red worms; while that which had been prepared was perfectly sound, and apparently stronger than ever. The only point in which the experiment could be suspected of having failed was in the case of a very thick piece of rope, which was decayed at the ends, although it had been immersed in the tank; on inquiry, however, we find that the rope was merely dipped in the solution, and not satured as it ought to have been; and therefore, the experiment, so far as this is concerned, cannot be considered a fair one.

"It was objected by one of the architects who witnessed the opening of the pit, that the pieces of timber were not large enough to test the preparation, and he expressed some doubts as to the possibility of saturating a large beam. The answer to this objection, we think, is easy; the object of the experiment was to ascertain whether Kyanised timber is capable of resisting the infection of dry-rot, and whether the piece used be large or small, appears to us to be quite immaterial. It is a fact proved beyond the possibility of doubt, that timber, of any thickness, may be saturated with the solution; but the use of thick timber in an experiment like this could not have produced satisfactory results, unless the pit had been allowed to remain closed for two or three years. The doubt, however, will now be most effectually met by another experiment. The timber taken out of the pit was again replaced in it yesterday, together with some pieces of a thicker description, and some bleached calico, and it will not be opened again until twelve months have expired. We had almost forgotten to mention, that an old silk handkerchief, which was put into the pit, after being dipped in the solution, was found to be unimpaired, not only in texture, but in colour."

Mining Journ.

On a new Voltaic Combination. *By* W. R. Grove, Esq., M. A.

On first hearing of porous porcelain being employed as a diaphragm for preventing the mutual precipitation of the metals on each other in voltaic combinations, it struck me that one of the plates of the metals usually employed might be dispensed with by precipitation upon the other from a me-

tallic solution. After some unsuccessful trials, I constructed a trough as following: a piece of common, stout millboard of the length required, and of breadth sufficient to form the bottom and sides, is separated lengthwise into three parallel divisions by cuts one-third through; it is then covered with a thin layer of cement and bent up into the form of a trough; four-inch squares of common sheet iron and unglazed porcelain plates of the same dimensions are then warmed and slid alternately into the trough, as in Cruickshank's form, at about three-tenths inch distance.* A solution of sulphate of copper and dilute acid being poured into the alternate cells, a very active series is formed by the precipitation of the copper on one surface of the iron; that which I formed was of twenty plates: the shock, without coils or condenser of any description, was so powerful as to be scarcely tolerable, when a wire was scraped along the edge of the plate at one extremity, the other hand touching the opposite end. The decomposition of water was also rapid, though I have not yet accurately measured its powers: its action continued unabated for nearly three hours without the addition of any acid or sulphate. If greater constancy be required, the alternate cells can be filled up with coarsely powdered sulphate, and some added as required. I was fearful that upon a second trial the intensity would have much abated, in consequence of the oxidated surface of the plates preventing so uniform a deposition of the precipitate, but was gratified to find that, after having been suffered to dry and remain at rest for several days, its action was as intense and constant as upon the first trial. The advantage of this form, where series and sustained power are required, I consider to be its extreme economy, a single cheap metal being employed instead of two expensive ones; the greater durability of iron as compared with zinc; the cutting in squares, so that none is wasted; and the tiresome process of soldering being altogether dispensed with. The diaphragms and solutions are common to every form of constant battery: possibly very thin plates of deal might do as well as porcelain; the durability of the latter material, however, makes its expense unimportant. My object in this communication is not so much to vaunt this particular form of battery as to direct increased attention to the porous filter as likely to form an important element in the analysis of the voltaic trough: it may possibly throw some light upon the organization of the torpedo.

W. R. Grove.

Swansea, Oct. 26, 1838.

Lond. & Edin. Philos. Mag.

"*On the relative attractions of Sulphuric Acid for water, under particular circumstances; with suggestions of means of improving the ordinary process of manufacturing Sulphuric Acid.*" *By* Henry H. Watson, Esq., *Corresponding Member of the Manchester Philosophical Society. Communicated by* John Dalton, D. C. L., F. R. S., &c.

The object of the inquiry detailed in the present paper is to determine at what degree of concentration the affinity of sulphuric acid for aqueous vapour is equal to that of anhydrous space for the same vapour at given

* Pasteboard is preferable to wood for the formation of these troughs: it has not strength sufficient by its warping to crack the cement, is much more easily constructed, and is a better insulator; it should be thinly coated with varnish on the outside to prevent capillary absorption by accidentally touching liquids. The plates of porous ware here mentioned may be conveniently employed for rendering constant the common Cruickshank trough, being warmed sufficiently to melt the cement and slide into the cells.

temperatures. It has long been known that concentrated sulphuric acid abstracts moisture from the atmosphere, but the amount and the rate of this absorption have never been ascertained with accuracy; and consequently, in applying this acid to purposes of exsiccation, the experimenter has often been at a loss to know whether the acid was sufficiently strong to render the space in which it was confined perfectly anhydrous. By placing portions of the acid, previously weighed, and diluted with known quantities of water, under the receiver of an air-pump, with equal portions of concentrated acid, of the specific gravity 1.8428, in similar dishes, the author ascertained that the dilute acid could be concentrated to the specific gravity 1.814, at a temperature varying from 65° to 57°: whence he concludes that acid of such strength is capable of drying a vacuum when the temperature does not exceed 57°. By making similar experiments in air, the author compared together the weights lost by ten grains of dilute sulphuric acid of the specific gravity 1.135, at three different periods of the day for six days, taking note of the dew-point and the temperature; and infers that when the affinity of space for vapour, or the evaporating force, is equal to 0.15 of an inch of mercury, it is just able to balance the affinity for water of sulphuric acid of the specific gravity 1.249.

The author next instituted a series of experiments to ascertain whether the evaporation of water from dilute sulphuric acid is capable of being carried on to the same extent in air as in vacuo, and found that the evaporating force of air exerted upon such acid is less than that of a vacuum at the same temperature. He observes that his experiments offer conclusive evidence that the evaporation of water is not owing to the existence of a chemical affinity between the vapour of the liquid and atmospheric air; but thinks that they favour the notion that the obstruction to this process in the open atmosphere is rather owing to the pressure than to the *vis inertiæ* of the particles of air. He is also of opinion that improvements will hereafter arise from this inquiry with regard to the economical management of the process of manufacturing sulphuric acid, which process would be greatly expedited by the regulated admission of steam into the condensing chambers kept at a constant high temperature. Ibid.

On the process for obtaining the Bichromate of the Perchloride of Chrome, as viewed under the Microscope. By the Rev. Edward Craig, F. R. S. E.

I observe in your number for July, p. 78, a notice of the bichromate of perchloride of chromium, and of the process for obtaining it. It may perhaps be interesting to call attention to the exhibition of this process under the microscope, which certainly throws some light upon the action going on. It presents one of the most beautiful objects ever seen.

Put a very small portion of the muriate of soda on a thin flat glass, and add to it a drop of strong solution of bichromate of potass; lay this on the port-object, and adjust it to the focus of the microscope. Then place upon another flat glass a drop of sulphuric acid, and turn it down upon the other glass. The action commences. The sulphuric acid is seen attacking and breaking down the muriate of soda and setting free the muriatic acid. Crystals of sulphate of soda are speedily formed. The sulphuric acid acts also on the bichromate of potass, and sets free the chromic acid; crystals of sulphate of potass are also formed. Over these crystals of both kinds a multitude of green particles are observed, which are probably a chromate of potass, formed from one equivalent of the chrome in the bichromate, and

then the other equivalent of the chrome combines with the disengaged chlorine, and appears in large blood-red globules over the whole field. The operation when steadily watched is very beautiful; and it is one in which the microscope seems to develope with peculiar interest a process whose specific features are lost sight of in the retort. According to the view which is thus given of the process, it seems natural to call the product chlorochromic acid.

Ibid.

March of Steam.

As the year 1838 will most assuredly form a remarkable epoch in the history of steam navigation, it may not be thought uninteresting to trace the advances it has made since the year 1814, when one steamboat, of sixty-nine tons burden, floated in solitude on the British waters. The following authentic account of the number and tonnage of steam-vessels belonging to the British empire (including the plantations) from 1814 to 1836 inclusive, has been politely supplied to us by the secretary of the Liverpool Statistical Society:—

Year.	Vessels.	Tons.	Year.	Vessels.	Tons.
1814	2	456	1826	248	28,958
1815	10	1,633	1827	275	32,490
1816	15	2,612	1828	293	32,032
1817	19	3,950	1829	304	32,283
1818	27	6,441	1830	315	33,444
1819	32	6,657	1831	347	37,445
1820	43	7,243	1832	380	41,669
1821	69	10,534	1833	415	45,017
1822	96	13,125	1834	462	50,736
1823	111	14,153	1835	538	60,520
1824	126	15,739	1836	600	67,969
1825	168	20,287			

Mining Journ.

Increase of Steam-power in Lancashire and its immediate vicinity.

The following returns, which are taken from a Parliamentary document, will afford some notion of the astonishing progress which the cotton manufacture has made in Lancashire since the year 1835. From the most complete returns that have yet been procured of the steam power existing in the manufacturing districts, and which were furnished by the Inspector of Factories, it appears that the total steam power employed in the cotton mills of Lancashire and Cheshire was 24,597 horses. The increase since 1835, including the mills now in erection, is, according to the subjoined account, 17,413 horses, of which 2,036 are destined for purposes not connected with cotton manufacture, leaving 15,377 as the increase in the cotton manufacture alone, which amounts to 62 per cent. upon the power existing in the whole of the counties of Lancashire and Cheshire at the date of the former returns. The 2,036 horse power not destined for the cotton manufacture, is divided as follows:—

Collieries	592	Canal	200
Woolen manufacture	410	Brewery	15
Woolen and cotton do.	88	Iron forges	35
Silk ditto	74	Nail making	24
Linen ditto	38	Wood grinding	30
Machine making	351½	Timber sawing	30
Corn mills	67		
Paper mills	82	Total	2036½

Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, MARCH, 1839.					Angles reckoned to the right or westward round the circle, asseen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
10	15	32	Im. 60 *a* Sagittarii	5, 6	94°	45
10	16	38	Em.		277	235
18	8	52	Im. 47 Arietis	6	50	103
18	9	24	Em.		337	27
22	12	13	Im. 47 Geminorum	6	67	122
22	13	10	Em.		258	311
30	13	4	N. App. ☽ & 68 Virginis 5, ☽ N. 0.′ 2			
31	15	17	Im. (1617) Bailey, Virginis	6	36	59
31	16	35	Em.		264	299

Meteorological Observations for September, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	73	81	29.62	29.63	W.	Moderate.	.01	Cloudy—flying clouds—rain.
	2	56	69	84	84	N.N.W.	Calm.		Clear—do.
	3	47	68	30.02	30.02	N.E.	Brisk.		Clear—do.
☉	4	59	74	13	15	N.E.	Calm.		Clear—do.
	5	60	85	12	12	E.	do.		Clear—do.
	6	66	84	12	15	E.S.E.	do.		Clear—do.
	7	62	84	15	05	W.S.W.	do.		Lightly cloudy—clear.
	8	61	81	05	05	W.N.W.	Brisk.		Clear—do.
	9	64	78	10	10	S.E.	Ca m.		Cloudy—clear.
☽	10	59	78	03	03	S.S.E.	do.		Cloudy—clear.
	11	64	74	29 86	29.86	S.	do.		Heavy fog—cloudy.
	12	63	58	91	64	N.E.	Blustering	4.00	Rain—do.
	13	60	72	54	81	W.	do.		Flying clouds—clear.
	14	56	74	30.05	30.10	W.	Calm.		Clear—do.
	15	59	77	04	04	W.	Moderate.		Flying clouds—clear.
	16	60	69	04	01	N.E.	do.		Lightly cloudy—do. do.
	17	59	69	29.85	29 8	N.	Brisk.		Cloudy—do.
⊗	18	64	76	11	64	N.N.E.	Calm.		Cloudy—clear—eclipse of sun.
	19	62	71	72	72	W.	do.		Lightly cloudy—clear.
	20	53	67	90	91	N.W.	do.		Lightly cloudy—cloudy.
	21	62	73	93	91	E.N.E.	do.	.09	Rain—cloudy.
	22	68	80	84	84	S.W.	Brisk.		Cloudy—flying clouds.
	23	72	54	73	73	SW.N.	do.	.44	Showery—do.
	24	46	64	30.00	30.00	W.	Calm.		Clear—do.
	25	48	68	13	13	S.E.	do.		Clear—lightly cloudy.
☾	26	59	63	17	13	E.	Brisk.	2.33	Stormy—rain.
	27	59	66	10	10	N.E.	Calm.		Cloudy—do.
	28	64	78	08	00	N.E.	do.		Cloudy—do.
	29	68	65	29.80	29.70	N.E.	do.	.40	Rain—cloudy.
	30	55	69	86	91	N.	do.		Flying clouds—do. do.
	Mean	60 23	71.97	29.95	29.91			7.30	

	Thermometer.	Barometer.
Maximum height during the month.	85. on 5th.	30.17 on 26th.
Minimum " " "	46. 21th.	29.62 1st.
Mean	66.10	29.93

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

JANUARY, 1839.

	County.	Town.	Observer.	Thermometer.										Barometer.	
				7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Register. Mean.	Register. Days omitted.	7, A. M.	2, P. M.
1	Philadelphia,	Philadelphia,	J. P. Espy.	28.19	35.89	31.23	59.	8.	31.77	1/2				30.08	30.02
2	Montgomery,	Norristown,													
3	Bucks,	Doylestown,													
4	Lehigh,														
5	Northampton,	Easton,	George Junkins.											29.85	29.76
6	Monroe,	Stroudsburgh,	Anna Maria Stokes.	21.09	33.64	23.73	50.	—10.	26.15	9				29.45	29.43
7	Pike,														
8	Wayne,														
9	Susquehanna,	Silver Lake,													
10	Luzerne,														
11	Schuylkill,	Pottsville,	John Porter.	21.55	31.76	25.71	52.	—8.	30.63		—8.	18.79		29.40	29.61
12	Berks,	Reading,	C. F. Egelman.	24.16	30.81	25.94	53.	—4.	27.30					29.87	29.84
13	Chester,	West Chester,													
14	Delaware,	Haverford,	Haverford School.	26.30	32.81	29.61	62.	5.	29.57	2 1/2	3.	21.26		29.55	29.48
15	Lancaster,	Lancaster,	Conservatory of Arts,	23.22	34.11	26.73	58.50	—2.25	28.02		—2.25	21.84		29.54	29.52
16	York,	York,	Calvin Mason.	31.82	35.60	29.25	58.	3.	32.22	6 1/2	3.	20.64	6	29.53	29.47
17	Lebanon,														
18	Dauphin,														
19	Northumberland	Northumberland,	Andrew C. Huston.	23.56	32.73	27.25	50.	—4.	27.88		—8.	19.77		29.48	29.47
20	Columbia,														
21	Bradford,														
22	Tioga,														
23	Lycoming,														
24	Union,	New Berlin,													
25	Mifflin,	Lewistown,	J. Culbertson, M. D.	27.64	32.01	30.07	51.	6.25	29.91	1 2/3				29.41	29.34
26	Juniata,	Mifflintown,	Andrew Parker.	27.71	32.76	31.93	50.	17.	30.80	10	14.	28.	10	29.56	29.58
27	Perry,	New Broomfield,													
28	Cumberland,	Carlisle,	W. H. Allen.	21.19	32.27	25.03	56.	—10.	26.16		5.			29.47	29.44
29	Adams,	Gettysburgh,	M. Jacobs.	22.38	32.53	26.10	58.	—6.	27.01		—6.50	18.84		29.49	29.44
30	Franklin,	Chambersburgh,	A. Thompson, Jr.	24.92	37.82	30.57	59.	4.	31.10	8 2/3				29.56	29.89
31	Huntingdon,														
32	Centre,	Bellefonte,	John Harris.	20.42	31.68	23.90	52.	—12.	25.33	1/3	—14.	12.19	2	29.28	29.29
33	Potter,														
34	M'Kean,	Smithport,	Richard Chadwick.	20.29	29.61	24.44	50.	—13.	24.74		—16.	14.50		29.78	29.77
35	Clearfield,														
36	Cambria,														
37	Bedford,														
38	Somerset,														
39	Indiana,														
40	Jefferson,	Rose Cottage,	Charles C. Gaskill.	19.27	34.13	26.56	48.	—20.	26.66					28.88	28.84
41	Warren,														
42	Venango,														
43	Armstrong,														
44	Westmoreland,														
45	Fayette,														
46	Green,														
47	Washington,	Cannonsburgh,	S. H. Kennedy.	36.23	36.48	26.59	58.	—5.	33.10					28.96	28.92
48	Alleghany,														
49	Beaver,														
50	Butler,														
51	Mercer,														
52	Crawford,	Meadville,	Fred. Huidekoper.	24.23	33.03	27.71	57.	—12.	28.32		—13.	20.24		28.78	28.78
53	Erie,	Erie,													

Barometer.							Weather.							Winds								
7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Rain.	Snow.	Rain and Snow.	1 hunder Showers.	Rain in inches.	Days omitted.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.
30.08	30.02	30.05	30.77	28.89	30.05	½	13⅔	16⅔						⅔	2⅔	3½	2	⅔	1½		½		⅔	⅓
29.85	29.76	29.79	30.83	28.70	29.80	1⅔	20	10⅓	3	3	6				1⅔		4⅔		2½		1			
29.45	29.43	29.43	29.89	28.65	29.44	9	9	12⅓						9⅓	5⅓		1		2⅓		1½		⅔	
29.40	29.61	29.67	30.13	28.50	29.56	⅓	11⅓	19⅓	3	2	3		5.433	⅓			2				5⅔			
29.87	29.84	29.86	30.25	28.90	29.86		6	25.	5	7	1				2⅔			⅓	3⅔	⅓	1⅔			
29.55	29.48	29.51	30.07	28.47	29.52	4⅓	5	18⅓	1	3			2.543	7⅔	⅔	⅔	5	1	1⅔		⅔		2	
29.54	29.52	29.55	30.32	28.56	29.54		11	20	2	6	6		5.143		1	2⅔	4⅔	⅔	⅓	⅓	3⅔	1⅔	1	
29.53	29.47	29.50	29.95	28.70	29.50	6									⅓		2		1⅓		2	⅔		
29.48	29.47	29.48	30.23	28.67	29.48		7⅔	25⅓		6	3		1.541		3⅓		2		3⅔		2	⅓	2⅔	
29.41	29.34	29.41	30.10	28.65	29.39	1⅔	8	21	5	4	3			2		⅔	2⅔	⅓			3½	⅔		3⅓
29.56	29.58	29.60	29.99	28.90	29.58	10	7⅓	23⅔							⅓		3⅓		2⅓		2⅔		1	
29.47	29.44	29.46	30.25	28.65	29.46		8⅓	22⅔	3		8		3.917		1	⅔	2⅔	1	1⅔		1		2	
29.49	29.44	29.45	30.28	28.68	29.46		9⅔	21⅓	1	3	5		3.380		2⅓	3⅓	3					⅔	8⅔	1
29.56	29.89	29.55	30.19	28.09	29.67	7⅔	10⅔	12⅔						7⅔										
29.28	29.29	29.32	30.09	28.53	29.30	⅓	6⅓	24⅓						⅓	6		6		1		⅓		2⅔	
29.78	29.77	29.81	30.70	29.10	29.79		5⅔	25⅓											3⅓		1⅓		1	
28.88	28.84	28.86	29.50	28.35	28.86		8⅓	22⅔					2.996				⅔	⅓	⅓		1⅔			
28.96	28.92	28.93	29.58	28.45	28.94		7⅓	22⅓					1.824	1⅓			1		3⅔		1⅓			
28.78	28.78	28.76	29.38	28.25	28.77		10	21	2	4	3		2.033		1	3	1⅓	1	7⅓	1⅓	⅔		3⅓	

Winds.												Hygrometer.				
S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Wet Bulb.	Days omitted.	No. of Report.
				3		2	1	3		5	3			33.60		613
				1		12		6								591
				3		1		5			9			29.95	11	595
				2		2		16		2						583
				3	3		2	14								582
		2		3		2		10.		2	1	16.32	6			581
	1	1		4			1	7	1			24.89		31.58		625
				4		2		11	1		6					579
		2		1		3.		5		7				40.77		589
			3	2			1	11			3					598
	1					5		6			10					590
	2			6		3		6		4		20.28	1	28.73	5	599
	8	1		1		2	1	6		1		20.357		29.387		584
												13.33	10	33.52	10	600
	2			4		5		4								632
	1			1		4		10		4						596
				6		4	1	4	1	10	1	29.28	6	33.64	9	603
				3		8		2		9	2					618
	3					4		2		3						619

LUNAR OC		
Day.	H'r.	Mi
10	15	3
10	16	3
18	8	5
18	9	2
22	12	1
22	13	1
30	13	4
31	15	1
31	16	3

Me

Moon.	Days	Su rise.
	1	73
	2	56
	3	47
♉	4	59
	5	60
	6	66
	7	62
	8	61
	9	64
☽	10	59
	11	64
	12	63
	13	60
	14	56
	15	59
	16	60
	17	59
⊗	18	64
	19	62
	20	53
	21	62
	22	68
	23	72
	24	46
	25	48
☾	26	59
	27	59
	28	64
	29	68
	30	55
	Mean	60 23

Maximum height
Minimum
Mean